Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

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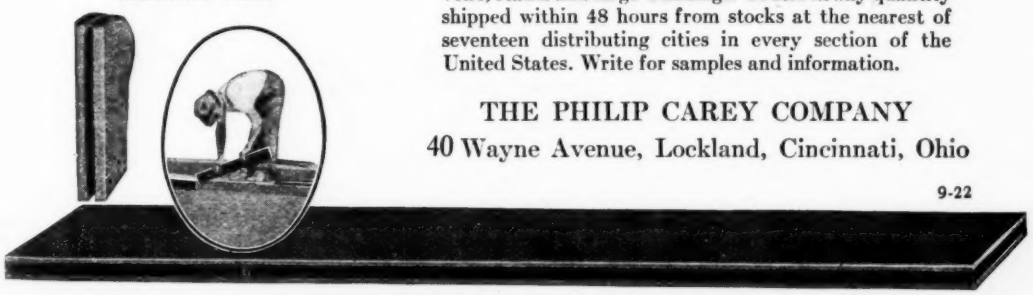

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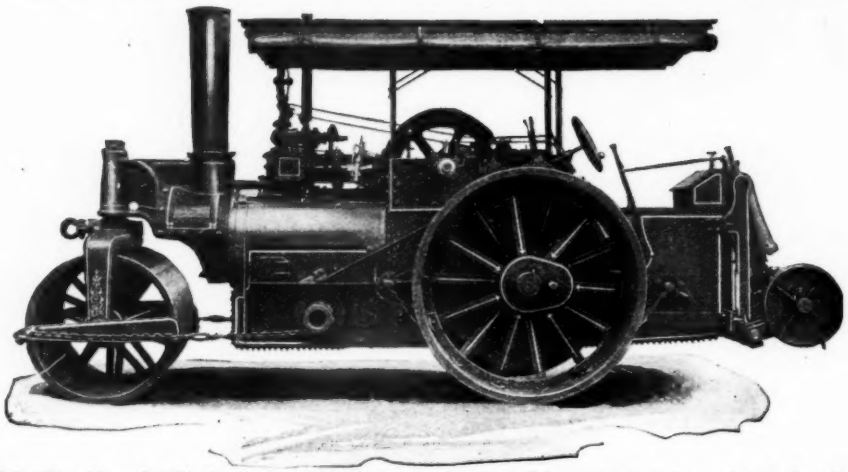

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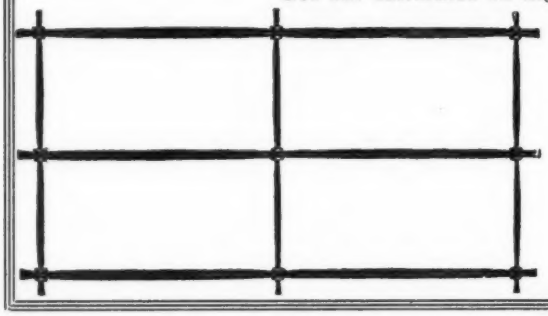

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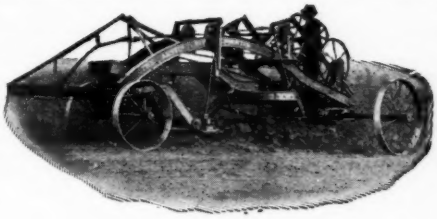

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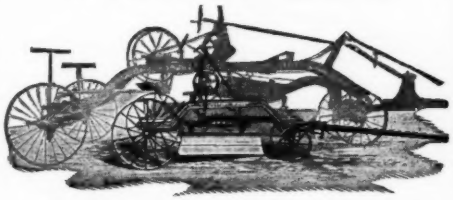

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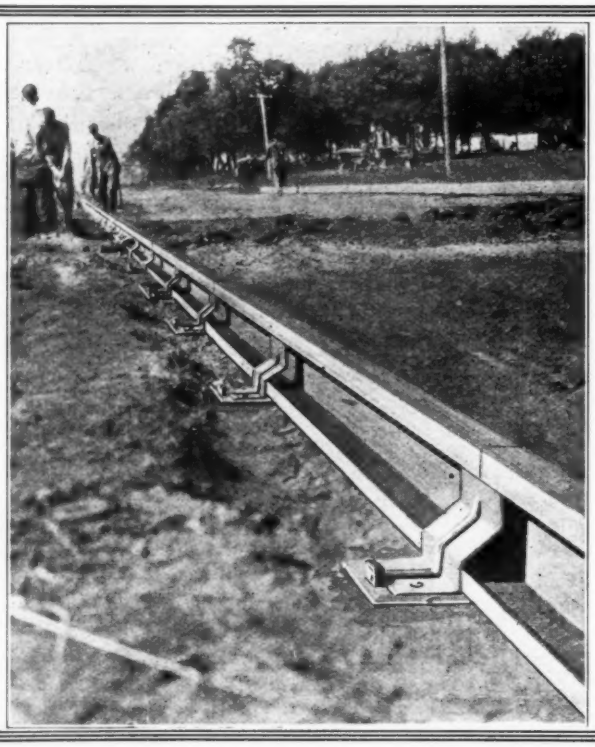

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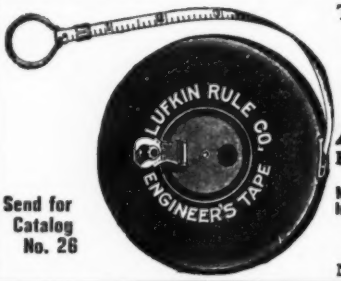

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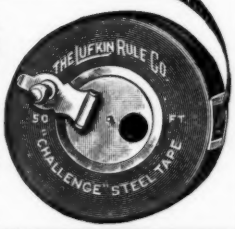

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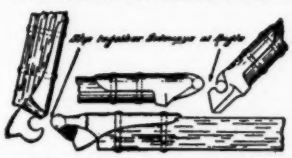

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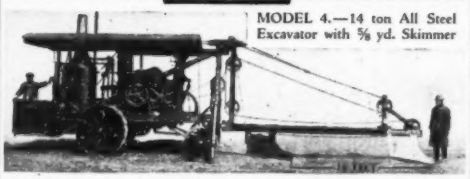

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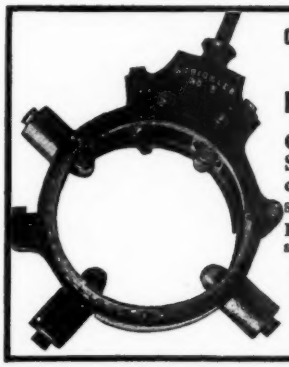

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EDITORIALS

ADVERTISING GOOD ENGINEERING

Engineers frequently complain that the public does not turn to the engineer for his professional services with the same regularity with which it turns to doctors and lawyers for their professional assistance. It is said that when the average man is ill he consults a physician and that when he becomes involved in a certain class of difficulties he immediately engages a lawyer, and that, in either case, he employs the best talent he can afford. On the other hand, it is asserted, that many times where an engineer is needed he is not engaged, and, if engaged, his ability is not always given due consideration. Undoubtedly there is much truth in these beliefs, and it is worth while to consider what can be done about it in the interest of the engineering profession as a whole.

The engineer is in the position of a manufacturer of a good article for which there is a large potential demand, but for which the active demand is not what it should be. In such a case the manufacturer advertises his product to make it better known and to increase its sale. The engineer also has something to sell for which there should be a more active demand, namely, his professional services. The suggestion that he should advertise his ability to render service has been given favorable preliminary consideration.

By advertising, in this case, we do not refer to general activities calculated to bring the engineer to the favorable attention of the public, but formal, group advertising in a popular magazine of large circulation. For the sake of illustrating the idea, let us assume that twelve pages of space be purchased in the Saturday Evening Post and that twelve full-page pieces of advertising copy be inserted in this space at the rate of a page per month for one year. Each page would have a primary circulation of 2¼ millions and a secondary circulation probably three times as great. The cost would be, we are told, about $75,000. The "copy" would be purely of an educational nature, entirely dignified and conservative, and designed to impress upon the public that it pays to employ an engineer when there is an engineering job in hand. There is an old definition of an engineer running as follows: "An engineer is a man who can do with one dollar what anybody can do with two." This might well be made the keynote of the campaign and be elaborated upon to show that it really pays in dollars and cents to employ an engineer when there is an engineering problem to be solved. This would undoubtedly make the public much more familiar, than it is at present, with the ability of the engineer to render money-saving service and would greatly increase the demand for engineers. The increased demand would, of course, be worth real money to engineers.

Here is an investment we should like to see the profession make. Immediately a question arises as to where the $75,000 fund is to come from. That, we admit, is a problem, but not one of such difficulty that its solution appears impossible. It is not unlikely that the American Association of Engineers could collect such a fund from the profession by receiving subscriptions from individual engineers and engineering firms. It might take two years to raise the fund, but that is surely a short period in the life of a great profession.

To any one who says the procedure recommended is unprofessional, undignified, etc., we can only say that if the reputable engineer's code of ethics and his idea of professional dignity will not permit him to make use of the instrumentalities employed by reputable business men, then there is something radically wrong with the engineer's ethics and his conception of dignity. If good engineering is in the public interest, what possible harm can result from telling the public about it?

STATE MOTOR AND HIGHWAY ORGANIZATIONS

While there are numerous organizations of men interested in motors and highways it is doubted that they are of the type best calculated to safeguard and develop highway transportation in all its phases, including, of course, the construction and

maintenance of roads and streets as well as the sale of motor vehicles of all classes, and including, also, the application of the vehicle to the roadway in passenger and freight transportation. There are now so many organizations among the automotive and highway people that the suggestion of new organizations will not be looked upon with favor until the need for them is more clearly understood than it is at present. It is the object of this discussion to call attention to the need for state organizations open to all who are interested in motor transport.

The numerous existing automotive organizations overlap but come far from covering the field of opportunity. They duplicate memberships and membership fees because of their narrow foundations and functions. Some men belong to several of these small organizations, of local scope, while other men do not "join up" at all. As a result there is much waste of time and money, much feverish but futile activity, much running around in small circles, and not so much as might be hoped for in the way of results.

The need for national organizations is admitted, but whether these are too many or too few it is not the present purpose to inquire. It is well to point out, however, that there is not enough affiliation and cooperation between national and local organizations to secure the best results.

Because of the bearing of state laws upon the use and development of highways the state is the proper political base upon which to build up motor and highway organizations. We should like to see in each state one organization made up of men in the automotive trades, men engaged in highway building and maintenance, and, most important of all, the users of the roads and streets. Such organizations can be made great in numbers, in resources, and in political influence.

The user has been overlooked much of the time and this is most unfortunate for users are numerous, wealthy and powerful. The user has a proprietary interest and should be admitted to membership in motor and highway organizations, because of his political influence if for no other reason.

In an average state there are two or more organizations of road promoters, road boosters or road builders, and in every city of consequence in that state there are two or more organizations of men in the automotive trades, and membership in these groups is always representative and sometimes extensive, while the great majority of highway users do not belong to an organization of any kind interested in the construction, maintenance or use of highways. For example, in one state only 10,000 out of 400,000 owners belong to the motor club.

The point to which divisions within the industry may be carried is for the men in the industry to decide; we argue only for united effort to safeguard fundamental, common interests.

There is a great deal of "anti" sentiment being worked up with reference to motors and highways. In 1923 as many as 43 state legislatures will convene and in every legislature one or more bills calculated to regulate or restrict motor traffic, or put it out of business entirely, will be introduced and pushed. The interurban railways make no secret of the fact that they will regulate trucks and busses out of business if they can, through legislation secured for that purpose, and they even propose exorbitant charges on passengers cars. This strikes directly at the highway construction movement itself, which may fairly be said to be under fire. How are the motor and highway interests to meet this attack?

We have given our answer to this question: we should have state organizations open to all road users, road builders, automotive trades people and all others interested in motor transport. Such organizations, if properly put together and well officered, can defeat adverse legislation. We do not consider fair regulation objectionable, in fact, it is to be encouraged, but legislation intended to cripple or kill highway transport must be defeated at all costs.

The highway user is likely to possess much more legitimate political influence than the man who sells motors or builds roads. The latter groups will be classed as purely selfish, whether they are or not, by the legislator, and the same is true of commercial users, but he cannot accuse the general run of business men, who use highways and motors incidentally in the conduct of their business, of being purely selfish for their interest is the very thing that constitutes the true public interest. Into these state organizations there must be brought, therefore, as many as possible of the great number of people who have an incidental interest, as distinguished from a vital, direct commercial interest, at stake in motor transport.

MARKING MANUFACTURED PRODUCTS AS AN AID IN APPRAISAL WORK

By W. Malcolm Lowry, of Henrici-Lowry Engineering Co., Consulting Engineers, 222 Commerce Trust Bldg., Kansas City, Mo.

Many new conditions have appeared within the last few years which have enlarged the scientific appraisal field. The co-insurance clause in fire insurance accounting, the income tax, and refinancing have contributed many requirements which only an inventory and appraisal can satisfy. The war valuations of plants and processes, the liquidation of government contracts, all have made necessary a complete history of the investment. The capital values of plants have not been properly determined in many industries, therefore a physical examination is essential for book accounts. Together with the above belongs the appraisal made for bondholders, the valuation for purchase or sale and the earning level for rate-making purposes.

In any carefully prepared inventory the listing and description constitutes the basis for establishing physical value.

To those who have actually compiled the field notes on a large plant, or have assisted in placing values on a certified inventory, it will be unnecessary to recount the causes for delay and uncertainty occasioned by the inherent lack of description pertaining to all classes of machinery, especially if the appraisal is based on reproducing the plant with similar or duplicate equipment.

The instructions given by our office to all men engaged in listing physical property make it obligatory upon them to secure full data, but in many cases circumstances prevent its accomplishment.

One element of this difficulty can be easily remedied if manufacturers would properly mark all of their products. In a recent appraisal for a steam and electric railway shop a large portion of the equipment was practically without name or number.

Frequently in a woodwork or metal machine shop, various types are encountered without a single mark of identification or name plate.

The writer would respectfully suggest that the manufacturers recognize the duty they owe to the purchaser and assist in making the owner permanently able to establish the usefulness and value of his equipment.

In many pieces of equipment the producer could easily cast into the frame such description as would not become obsolete or incorrect by wear. This could include the name of manufacturer, his address, a serial number, the size of the distinguishing portion such as cylinders of engines, bed plates on planers, limit or size of lathes, maximum range in capacity of shears and presses, areas of manglers, cubic contents of tumblers and separators, capacity of freezers, ice crushers, receivers, description of boilers and other equipment. The above are only random items, and each class could be given a proper classification. On certain classes of special machine design, the duty or classification could well be shown in one word as "Planer."

The casting into the machine of its shipping weight would be extremely valuable, for from this could be worked out a per pound unit.

The year probably could not be used except in cases of machine constructed upon definite sales order.

There are certain disadvantages to such a procedure, but from a large experience it appears that much time could be saved in compiling inventories, if all machinery were marked more completely and in convenient location.

A serial number is generally found on machines of large capacity, but often this is placed on a removable plate attached by screws. The electric motor manufacturers are to be commended upon the manner in which all articles and types of equipment are described and other pieces of apparatus could well be lettered and named. The manufacturer is frequently put to expense in answering letters from engineers asking for just such data as could easily be cast in the main frame.

The writer realizes that many machines are stock manufactured and sold without the factory's regard for permanent advertising or responsibility, hence the lack of identification, but even on such articles a weight could be given which would be of service.

Many valuation engineers have been compelled to prepare elaborate machine schedules in order to overcome this problem, and while most of our offices are now able to distinguish the unknown in the present machines, new processes are continually presenting themselves, bringing along new types of machines which will be hard to estimate in the future.

The owners could also be of great assistance if proper office records were maintained, giving the history of all pieces of

apparatus purchased and installed, but experience shows that many factories are without complete shop data, hence the appraisal.

Only last week our office had occasion to list some equipment and one piece of uncertain age was encountered which required the field engineer to make a detailed sketch in order to secure proper notes.

It is possible that manufacturers have some well-defined reasons for this omitting of such data. However, to the appraisal engineer its appearance would be very welcome.

Should it be possible to let the manufacturers know of the many demands for appraisal inventories, it is probable that they might all consent to these little refinements to their machinery and equipment which would be of lasting benefit.

It is hoped that the future appraisal engineers will find all new equipment permanently and properly marked.

STANDARDS AND STANDARIZATION WITH SPECIAL REFERENCE TO PAVING BLOCKS

By George W. Tillson, Consulting Engineer, 313 So. Catherine Ave., La Grange, Ill.

So much has been written during the past few years upon standards and standardization that it might seem almost futile to say anything upon these subjects at the present time. It may be possible, however, to state a few facts in such a way that they will be of some benefit.

A standard is a model, something that can be profitably copied. It follows, then, that the standard should be set up only by one who is a recognized expert on his particular subject. Some years ago the bridge specifications of Theodore Cooper were generally admitted to be standard, as it was well known that Mr. Cooper was past master in the knowledge of bridge construction and of the requirements of the materials used therein.

When a motor was desired for the use of American airplanes in the World War, experts, not simply in motor construction, but experts in each particular part of a motor, were called in so that the completed product was one that was standard and perfect according to the knowledge of that time.

There is little doubt that if all automobile industries in this country were under one control and the best design for each particular type of car were used by all factories the cost of automobiles would be materially reduced. One object, too, of standardization is to set up a model that will serve as a copy to those who wish to produce a certain result, but have not the particular knowledge to effect it.

One point must be considered here. A standard is supposed to be the best of its kind. But in practical work what is theoretically the best is not always economically so. The writer was once called down quite severely by his professor in college when in an essay on "Foundations" he made the statement that rock makes the best foundation, the professor's argument being that oftentimes sand is as good as rock.

Granite Block.

Perhaps the greatest care in using or making standards is necessary in specifications for public work. Some 12 or 15 years ago the municipal engineers located in and near New York City met together with the producers of granite paving blocks to see if they could not agree upon a uniform size for these blocks. It had been found that the called for sizes of granite blocks in New York, Philadelphia and Boston, while practically the same, differed enough to prevent the use in one city of those manufactured for another. The ill effects of this can easily be seen. A granite man might have a surplus of Boston blocks when there was a large demand for blocks in New York which he could not supply, and the same might be true of Philadelphia.

Besides obtaining a uniform size the engineers wanted a better block. They recognized the fact that the public was calling for better stone pavements and were ready to pay for them. The producers were called in to ascertain what effect certain changes in dressing and uniformity in widths would have on prices. They knew that it would be easy to specify a block so dressed and so laid as to produce a perfectly smooth pavement, but its cost would be prohibitive. What was desired was to know just how far they could go with their requirements without making the expense too great. The best granite pavement the writer ever saw was laid in Glasgow, Scotland, in 1913. The blocks were uniform in size and dressed upon every side but the bottom. The top was smooth. The pavement laid complete cost $5.25 per sq. yd., which before the war and in Scotland was a very high price.

The result of this conference produced a block that was very generally adopted. Shortly after this the organization for standardizing paving specifications was

perfected and carried on the work. This society later merged with the American Society for Municipal Improvements, and this latter organization is now studying specifications for all municipal work and revising them when necessary. But, as has been stated before, these specifications must not be followed blindly. They can, however, always be depended upon to give good results, but it may sometimes be at too great cost. Certain grades of stone may be specified, when local stone, not perhaps fully up to the standard, may be used with satisfactory results. A good instance of this can be seen in the roads constructed by the New York Board of Water Supply around the Ashokan reservoir, a few miles west of Kingston, N. Y. These roads are nearly all of asphaltic concrete laid upon a broken stone base. There was an unlimited amount of hard sand stone in close proximity to the work, but of course it would not stand the tests required of stone in standard specifications. The cost of trap rock would have been very great, and accordingly it was decided to use the local stone. The results have certainly proved the wisdom of this course.

Paving Brick.

In the manufacture of paving brick there has probably been a greater diversity in sizes and styles than in almost any other industry.

At a conference of engineers, manufacturers and others held at the Department of Commerce, Washington, last November it was shown that there were 66 different styles of bricks being used in street pavements, the manufacturers either working according to their own ideas or the whims of engineers who had not given the matter careful consideration. The importance in having paving brick of uniform size is greater than in the case of granite blocks, as brick plants are so much more numerous and scattered over so large an area of country. Bricks of the same quality shall be interchangeable no matter from what plant produced. This is necessary not only in case of an unexpected shortage in construction, but also in making repairs. This conference gave the matter careful consideration. It was made up of state, county and municipal engineers, representatives of nearly all of the paving brick manufacturers of the country, representatives of the Department of Commerce, as well as others interested in the subject. The result was that a resolution was adopted recommending that the 66 styles be reduced to 11 specifically described in the resolution, and at a subsequent meeting the number was reduced to seven.

The meeting felt that, while it had no power to enforce its findings and could only recommend, the effect of such action by such a body would be immediate and must bring good results.

The writer has always been strongly in favor of standards and standard specifications, but wishes to reiterate what he has previously said that they should be used understandingly with a knowledge of why this thing or that is required, so that any omissions or additions may be made without producing a document that would be inconsistent and of little value.

THE WAREHOUSE AND ITS RELATION TO HIGHWAY TRANSPORTATION

By Russel N. Edwards, Engineer and Architect, 46 Union Trust Bldg., Indianapolis, Ind.

(Editor's Note.—The present article gives the views of an engineer as regards the requirements of the future warehouse and its relation to transportation, distribution and business problems, as presented to the members of the Indiana Transfer and Warehousemen's Association.)

The relationship of the warehouse to transportation, distribution and business is well illustrated by our postal system. When a manufacturer in Indianapolis desires to communicate with his jobber in Laporte, he writes a letter, places the required postage thereon and mails it. He knows that in a few hours that letter will be delivered to the door of the addressee. In like manner packages containing that manufacturer's wares, within the limits of certain weights and sizes, may be forwarded over the same route.

How about other commodities whose weight and size require a shipment by freight? I need not tell of the various stages of such a journey, of the congestion at freight terminals; of the delays between the unloading at the outbound door of the terminal and the loading into a car; of its arrival at some transfer point with a further delay. Next of its receipt at the freight warehouse in the consignee's city; the notification of its arrival; of the storage and demurrage charges if not called for by the consignee within a specified time, and finally of its ultimate delivery.

No, you have a mental picture of every step in the process; you are in daily con-

tact with these vexations and know what they mean in loss of time, money and damaged goods. Compare the two systems, the United States Government postal service and the hit and miss of our present freight transportation and ask yourself which is most efficient.

Suppose I visualize for you the future freight transportation. Just let your fancy wander to the point of causing the postman to fill the place of the truckman. Let the mailbag be pictured as a truck and let the postoffice fade into a modern warehouse equipped with the last word in handling equipment. With such a background it is my purpose to fill in the details of the picture.

The development of the motor truck and good roads has been of such recent date that a clear perspective of the relationship of highway trausportation to rail and water transportation hitherto has not been granted us. The great importance of the part that highway transportation plays, or can be made to play, in supplying the economic demands of the nation, was forcefully impressed upon us at the time of the threatened general railroad strike. There is not a question but that highway transport could have been so well organized, under government direction, that the vital necessities to human existence could have been indefinitely supplied.

We only need to recall the varied uses that trucks are now called upon to perform to realize that some agency or organization could bring about such a new order of things that the manufacturer or producer could dispatch his commodity to the jobber or ultimate consumer with the same assurance of its ultimate delivery that he now has for his letter or parcel post package.

Our warehouse, under such direction, would then become a highway transport clearing house through which, just like the postoffice, a variety of incoming commodities could be sorted, grouped and packed into empty demountable truck bodies and labeled for a predetermined destination. The truck bodies could then be mounted upon a chassis and sent out on schedule over a known short haul route, or to a railway or water terminal for trans-shipment on longer hauls.

Any loaded truck body could be removed at destination for further handling. A return load body could be picked up, attached to the truck chassis and be delivered to the clearing house. Just keep in mind the postal system and you will visualize the plan.

The system could no doubt be carried still further and the truck bodies, as originally loaded at the clearing house, could be mounted on special railroad flat cars or placed aboard ships and thus be delivered to long haul points. Thus much handling as well as a great deal of time and money could be saved.

The whereabouts of these truck bodies could be recorded in a similar manner to that now employed by railroads to keep track of their rolling stock.

Other problems enter into such a project, such as meeting the fluctuating demand of motor transport, rate making, classification determinations, maintaining schedules and educating the shipper, the consignee and the general public to the advantages of this type of transportation. With a motor transport clearing house properly organized and with an able administrative staff, the details of the practical application of the principles could be worked out.

Let us lay aside this panoramic view and get down to a little more detailed picture of the actual warehouse building, our future motor transport clearing house.

The Warehouse Building.

The selection of a suitable site is the first consideration. Without the proper location we handicap ourselves at the start. An ideal site should have streets on one side and the front, with switch tracks along the other side. An alley or private driveway in the rear and between switch tracks is also desirable. In general the site should be close to the downtown district of the city, near enough to railroad freight terminals to facilitate short hauls, and on ground that is not valuable at a prohibitive figure.

The building itself should be fireproof. A reinforced concrete design, with flat slab floors supported upon round columns, will be found to be the most economical. The width of the building should be a multiple of the width of a bay, a bay being the distance between two rows of columns. The most practical bay width is approximately 18 ft. Therefore, your building could be 72 or 90 ft. in width.

In height it is more economical to erect several stories than a few, because small increases in the width of foundation take care of additional loading and the same roof will cover one or ten stories. Any future additions should be added to the length, rather than to the height.

The walls should be supported on each floor and built in between the outside columns. Hollow tile or brick makes good

wall construction. The hollow tile can be stuccoed on the outside if desired. Since stored goods would usually shut off the light from windows, a line of steel sash lights high and near the ceiling is sufficient.

Platforms should be built along the street side and also the railroad track side. A width of not less than 10 ft. is to be desired. Sometimes a ramp at either end of the platform will be found useful in giving access to the floor or platform elevation from the street or railroad grade line. These platforms should be at car floor or truck floor height above such grade.

Roller steel curtain doors should be provided on the first floor to give ample access to both platforms, for incoming and outgoing shipments.

To facilitate the rapid handling of shipments, either as packages or truck body loads, such things as elevators, moving conveyors, spiral chutes and even cranes and overhead tracks should be carefully considered.

Ample aisle space should be marked out in black paint on all floors, and no goods in storage should be allowed to extend beyond such lines.

Pneumatic tubes for order carrying from the general office to flood stations, as well as dictograph inter-communicating telephones, should be a part of the system, making for quick transaction of business.

The sanitation, heating, lighting and sprinkler systems must be given their consideration and provided. In cold storage warehouses the additional piping system to handle the medium of refrigeration would have to be installed.

We are of the opinion that the first floor should be arranged for the handling of truck bodies. It should be divided into route sections. Local cartage vehicles should deliver to platform, and there the packages should be routed to the sections where truck bodies are being loaded for outbound shipment, or to storage or freight cars, as the case might be. Incoming loaded truck bodies should be run into space allowed to receive them, their contents sorted and routed. When empty they should be immediately moved to outbound section for refilling.

Outbound goods from storage, from freight cars or from local short haul routes are treated in the reverse manner. Loaded truck bodies, as well as freight cars, should clear as soon after being loaded as possible. Ample head room on the first floor and traveling cranes in each bay would facilitate these movements. All terminals should be cleared daily.

Thus highway transportation can be made to relieve railroad and water terminals of the short haul and stabilize what is now a chaotic condition in transportation. It is rapidly coming to the relief of the railways in this perplexing problem. The construction of highways that will stand the punishment of heavy loads will in the next ten years produce tupendous results that should be anticipated by the erection of motor transport clearing houses now. Its value to transportation has been demonstrated in the motor truck terminal operation inaugurated in 1916 at Cincinnati by the Big Four Railway.

Transportation has long awaited the coming of the motor truck, and the motor truck will enter fully into its place as a great transportation agent when the crystallizing influence of motor transport clearing houses will apply it as only such an institution can make the application.

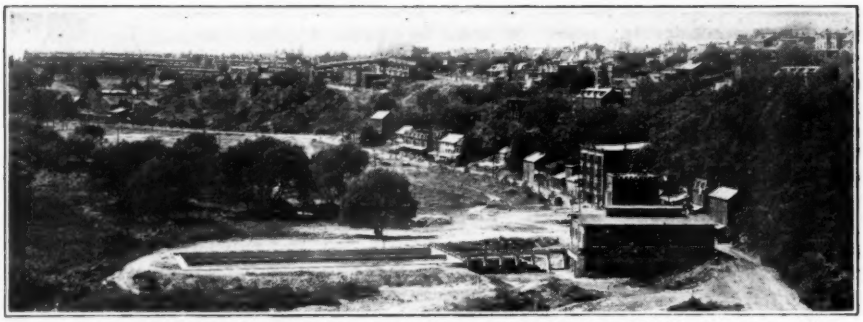
SUCCESSFUL OPERATION OF DIRECT OXIDATION PROCESS OF SEWAGE TREATMENT AT ALLENTOWN, PA.

By Harry F. Bascom, C. E., City Engineer, Allentown, Pa.

The city of Allentown, with a population of approximately 90,000, is located on the Lehigh River, at a point approximately 18 miles above its confluence with the Delaware River, 92 miles west of New York City and 62 miles northwest of Philadelphia. The city is located on a limestone formation, well elevated, consequently well drained, and in the greater part of the city the sub-surface formation, consisting principally of limestone, is of such a loose and open character as to readily accomdate such household wastes as are emptied into the cesspools or "sink holes," as they are called locally.

Until about 1900 no concern was given to the existing conditions, but with the rapid development of the city various difficulties were encountered in disposing of the house sewage by the use of the cesspools, and in many instances connections were made to the existing storm water sewers because of the lack of other facilities.

Commencing in 1902 various investigations were conducted, consulting engineers were engaged and in 1908 plans were prepared and approved and permit issued by



VIEW OF DIRECT OXIDATION PROCESS SEWAGE DISPOSAL PLANT AND SURROUNDINGS, ALLENTOWN, PA.

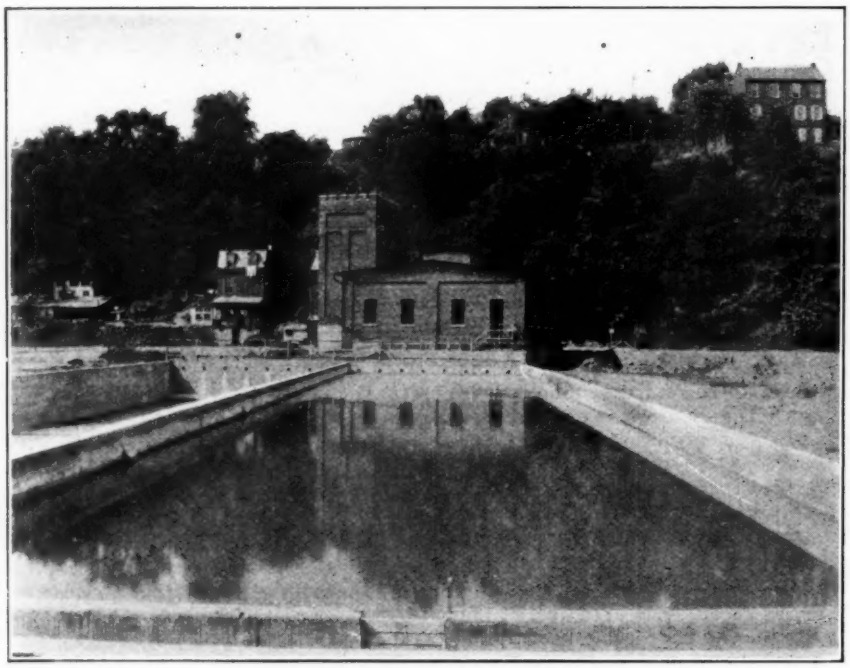
Plant is in Foreground. Building at Right Contains Mechanical and Electrolytic Apparatus. Left of this are Sludge Beds and Left of These are the Sedimentation Basins, Buildings on Main Street of City at Extreme Right.

the State Department of Health for tanks and sprinkling filters at an estimated cost of $987,000.

This plan did not meet the approval of the electors and was rejected Feb. 16, 1909. In 1914 new plans were prepared, a new site of 462 acres was purchased for $120,000 and a second permit was granted by the State Department of Health, April 18, 1917. Because of its close proximity to the city of Bethlehem, which derives its water supply from the Lehigh River, these plans were also rejected and the tract sold in 1920 for $140,000 to the Lehigh Valley Railroad Co.

Early in February, 1918, under the writer's supervision, the city through its engineering department and with the cooperation of the city laboratories, under the direction of Dr. H. J. Krum, conducted an investigation of the direct oxidation process, which was being demonstrated at Easton, Pa. A few days later the Franklin Institute also conducted a test upon the demonstrating plant.

As a result of the conclusive data ob-



ALLENTOWN SEWAGE DISPOSAL BUILDING VIEWED FROM END OF SEDIMENTATION BASINS.

Tower at left contains lime storage equipment. Basin outlet in foreground center. Residences are shown directly opposite building.

tained from both these investigations, together with the complete absence of nuisance and the small area required, and because of the extreme purity of the effluent necessary to protect the water supply of Bethlehem immediately adjoining, plans and specifications were prepared and approved by the State Department of Health Oct. 1, 1919, for the construction of a sewage treatment works embodying the Direct Oxidation process, "or its equivalent," at an estimated cost of approximately $200,000, which included sedimentation basins and sludge beds.

Description of Plant.

The disposal plant is located on Lawrence St., not more than 700 ft. west of the Eighth St. bridge, covering an area of 0.57 acres, and serves sewage districts Nos. 1, 2 and 14, from which a flow of 1,910,000 gals. per day of sewage uncontaminated with trade wastes, will ultimately be obtained, giving a maximum daily flow of 3,800,000 gals.

Screen Room.

The sewage enters the building from the street mains, then to the intake channel, then through either of two shear gates, over an inclined screen 8x8 ft., with openings of ¼-in. diameter. The solids, larger than the ¼-in. opening, are retained on the screen and are brushed by five revolving brushes, supported on an adjustable frame and driven by a 1 h. p. motor, the speed of the brushes being about 1 ft. per second.

The screened solids are allowed to drain into the grit chambers. They are then incinerated in a 1 ton nominal capacity DeCarie incinerator during the winter season, but during the summer season the solids are buried. The screen room is the only place where raw sewage can be seen, and the only place in the whole plant where any odor can be detected.

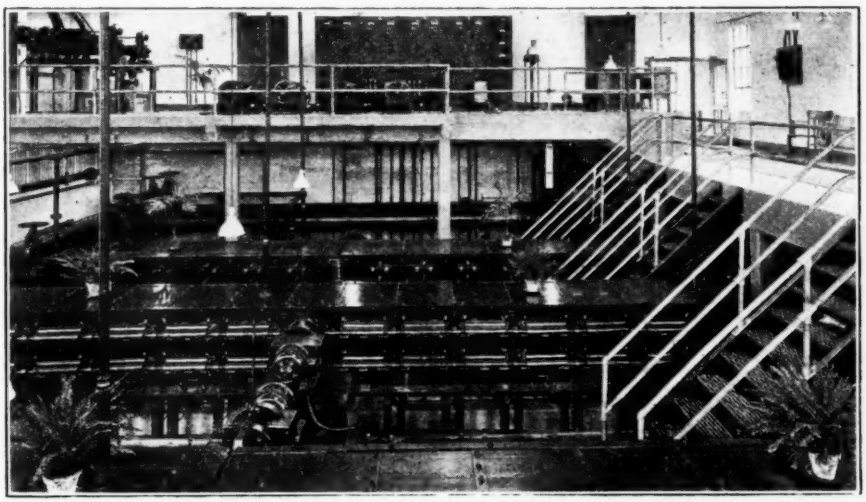
Grit Chambers.

Under the screens are the grit chambers of approximately 170 cu. ft. capacity. From the grit chambers the sewage flows over the overflow wier, through the Venturi meter to the entrance of the electrolyzers.

Lime Tower.

At some point in the line, as far ahead of the entrance to the elctrolyzers as possible and between the electrolyzers and the Venturi meter, pipes are connected to admit of the introduction of the lime which has previously been crushed, pulverized and stored in the lime tower. The lump lime is received in carload lots, transferred by truck to the plant, where it is put through 6-in. grids to the crusher. After passing through the crusher the lime is elevated and stored in the storage tank of 50 tons capacity. Each day when required the crushed lime is pulverized.

The lime feeders are operated by a 1 h. p. motor and the equipment is in duplicate. From the effluent end of the electrolyzers, treated sewage, to be used as a conveying medium for the lime, is pumped, requiring a 2 h. p. motor. This is discharged tangentially to the frustrum of a



VIEW OF INTERIOR OF BUILDING, ALLENTOWN SEWAGE PLANT.

Electrolyzing units on the lower floor. Beyond these, at the right, the venturi meter, with its recording apparatus on the gallery above. On the gallery, at the right, the attendant's desk; in the center, the switchboards, one for each electrolytic unit. At the left, the lime feed apparatus.

cone, where it is mixed with the powdered lime, and both are then discharged into the mixing tank or box. The lime in solution is then run into the pipe leading to the entrance of the electrolyzers, where it receives the specific treatment of the process.

Electrolyzers.

The electrolyzing units, or electrolyzers, three in number, each with a capacity of 1,000,000 gals. per 24 hours, are of the appearance of an enclosed vat 3 ft. wide, 2 ft. 9 ins. high and about 27 ft. 3 ins. long. The top cover in two sections is securely bolted down, resting on rubber gaskets, to make the vat water tight. The cover is made in two sections, to facilitate removal for examination and for cleaning. From the top cover two iron pipes lead upwards several feet to conduct any accumulated gases which may collect in the unit.

The electrolyzer is mounted on vertical wooden legs and over an outlet trench of concrete, which any leakage flows to the sump pit. Underneath the units are located 14 valves for the purpose of cleaning the machine, and this waste sewage also flows through the concrete trench to the sump pit. Sewage enters through a 12-in. pipe, and after a travel of approximately one minute of time through the machine emerges through another 12-in. cast iron pipe at outlet end.

In the electrolyzer, constructed of cypress, are placed 22 sets of electrodes placed 11 sets superimposed above the other 11 sets. Each set of electrodes consists of mild steel plates 3-16-in. thick and 10x16 ins. in dimensions, bolted together at the four corners. Between the mild steel plates and around the bolts are bushings of insulating materials which separates the plates ⅜-in. uniformly. The plates are so connected to and insulated that when joined in the electrolyzing circuit they are alternately positive and negative.

In each space are two paddles 10⅛ ins. in diameter, constructed of non-conducting materials and attached to shafts extending through holes in the plates.

These paddles are entirely insulated from the mild steel plates. The 22 sets of 48 plates each, or 1,056 total, are set across the axis of the machine, the plates being vertical and parallel in rows. The spaces between the sets of plates and the cypress sides of the machine are blocked, thus compelling all of the sewage to flow through the ⅜-in. spaces between the plates. The entire set of paddles are driven by a 3 h. p. motor through a double reduction gear box rigidly attached to the machine, and to two lines of protected bevel gears on the side of the machine attached to the shafts carrying the paddles. The bevel gears operate in oil.

The paddles keep the surface of the plates clear and free of sludge and debris. They also act as mechanical depolarizers. The speed of the paddles is about 20 R. P. M. At the bottom of the electrolyzer units are several valves, through which any accumulation of dirt or grit which may have accumulated is drawn off.

Power Board.

On the slate power board are placed the controlling switches and meters, a rheostat to adjust the current delivered to the electrolyzers, a Watt meter and a pole changer. The polarity of the electrodes is changed periodically to equalize the possible deterioration of the plates and to prevent the building up of the coating of the lime in any of the plates. The normal operation of the machine is at 45 to 55 volts and 50 to 55 amperes, the Watt meter, which registers the power to move the paddles, operates under a normal load of 1,200 to 2,500 watts.

The cells in the electrolyzing unit receive a direct current from a 5 KW. generator, driven by 7½ h. p. motor. The paddle-turning motors are 3 h. p. As each plate had an area of 120.2 sq. ins. per side, and as the 48 plates are electrically connected, so that alternate plates have the same polarity, there are 47 sides, having the same polarity, and each bank contains 5,649.4 sq. ins. of positive and negative electrode area. The total positive and negative electrode area in the apparatus, which contains 22 such banks, is therefore 124,286.6 sq. ins., and the total number of paddles is 2,068.

The efficiency of the apparatus becomes apparent, for it is equivalent to compelling the sewage to flow between electrodes 30 ft. high and 30 ft. long, spaced ⅜-in. apart, in which space 2,068 paddles are revolving, thus bringing every particle of sewage into intimate contact with the electrodes, and thereby utilizing the oxygen and hydrogen while in its nascent or atomic state.

Sump Pumps.

Two low grade gravity lines enter the plant to the sump pit and the main trunk line siphons are frequently drained to the sump pit for cleansing purposes. The two sump pumps are each operated by 7½ h. p. motors. Each pump is capable of raising 600,000 gals. sewage per day from the sump pit to the grit chamber. The pumps

have electric automatic connections and with tell-tale attachment.

To insure operation when the central power plant may be out of service a 30 h. p. Fairbanks-Morse oil engine was installed, which operates a 25 KW. Ac generator. This can be started at a moment's notice. Very few times, however, was it necessary to start this unit during the year.

The entire equipment is housed in a building formerly used as a pumping station, and is 42x72 ft. in inside dimensions.

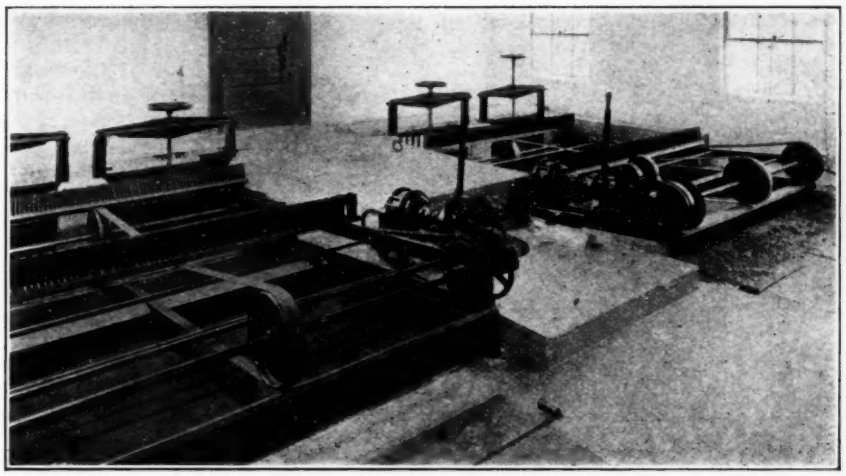
From the observation flume in the main building the sewage passes to and through an elevated reinforced concrete flume 2x3 ft. in section to the distributing flume at the inlet end of the sedimentation basin.

Here the sewage passes through eight port openings 6x6 ins. in section, the openings being regulated by adjustable port regulators to either one of two reinforced concrete sedimentation basins. The dimensions of the basins are 150 ft. long by 31 ft. wide, and of depth at inlet end of 7 ft. and at outlet end of 5 ft. 6 ins. The capacity of each basin is approximately 230,000 gals. The basins are provided with 10-in. valves to draw off the clear liquid at the outlet ends, and at the bottom of the basins are 10-in. valves to draw off the balance of the liquid which passes to the sludge beds. Six-inch valves are also provided at the front ends. The sludge is drawn from each basin by gravity through five under drains and through five 10-in. valves.

The former site of the basin was a swamp, with soft soil bottom, so about 300 reinforced concrete piles 10x12 ins. in dimension were constructed at the site, and driven, on which to place the basin. The basin was thus anchored to prevent destruction by flood in the event that the filling around it be washed away.

Retention period in basins is from 1½ to 2 hours at full capacity of plant.

The sludge beds are 50 ft. long and 61 ft. 6 ins. wide, divided by wooden partitions into six compartments. These beds are underdrained by half sections of vitrified pipe, and above these is coarse stone, fine stone and coarse sand for the filtering medium.



VIEW OF SCREENS AND BRUSHES IN ALLENTOWN SEWAGE PLANT.
Screenings can be seen on the floor in front of the right-hand screen, where they are thrown by the brushes.

During the past year the plant treated 73,000,000 gals. of sewage without the slightest evidence of nuisance or complaint and produced an effluent which was consistently and uniformly stable and of low bacterial count. The sewage is a normal sanitary sewage, and its composition, as well as the average composition of the effluent, is shown in Table 1.

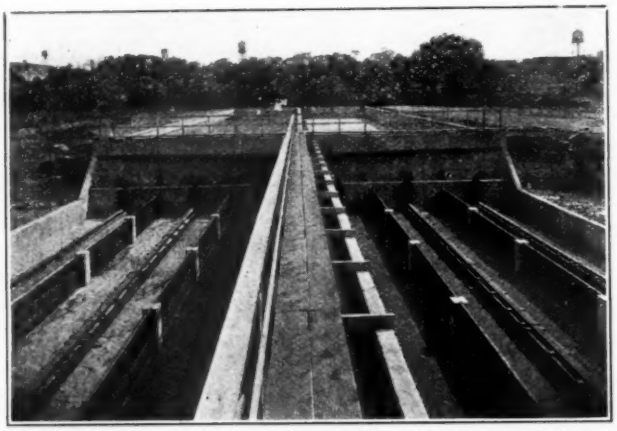
TABLE I—RESULTS OF DIRECT OXIDATION SEWAGE TREATMENT AT ALLENTOWN, PA.

Suspended Solids	Raw Sewage P. P. M.	Effluent (1 hr. set.) P. P. M.	Pct. Change.
Total	150	69	—54
Volatile	110	46	—58
Oxygen Consumed	17	8.1	—53
Free Ammonia.	21	13	—33
Nitrogen			
Dissolved ...	10.4	7.7	—26
Total	24.0	14.6	—39.1
Chlorine	117.0	123.0	+5
Alkalinity (as CaCO3)	287.0	50*	
Bacteria			
Total 37°C...	2,036,000	12,000	—99.6
B. Coli.	87,000	18	—99.98

*Causticity as CaO.

The sludge, as removed from the sedimentation basin, contains 94 per cent moisture and amounts to 21 cu. yds per million gals. After 4 to 6 days' drying on the sludge beds in normal weather the volume shrinks to 11 cu. yds and the moisture content drops to 71 per cent. Therefore, when dry the sludge will amount to about 3 cu. yds per million gals.

ness of the water supply. Allentown is unfortunate in this respect, in that its water supply is well above the average in hardness, and therefore requires much more lime than many other communities. However, during the past year accurate records of cost have been obtained, and as the flow is continually increasing these data have been computed and checked, and



SEDIMENTATION BASINS AND SLUDGE BEDS, ALLENTOWN SEWAGE PLANT. Walk in Center Rests on Flume Carrying Effluent to Basins. Sludge Beds Are in Foreground.

It is interesting to note that the wet sludge as taken from the sedimentation basin was absolutely fre of colon bacilli, contained 44,000 total bacteria, and when diluted with river water and distilled water had a stability of over 99 per cent, with methylene blue in dilutions ranging from 1 to 25 up to 1 to 1,000.

During the year the sludge has in the main been satisfactorily used for filling around the plant, although in some instances truckers have carted it away and used it on their farms, and they report that it is a very good growth stimulant, soil corrector and improves the mechanical property of the soil.

Regarding the cost of operation, this will vary in different localities due to labor, the cost of power and to the hard-

TABLE II—COST OF OPERATION PER MILLION GALLONS AT FULL CAPACITY OF PLANT (3 MIL-MILLION GALLONS).

Power 213 kw. hr. @ 2.8c	5.96
Lime 0.6 ton @ 9.10 per ton (86 percent CaO)	5.46
Operators $135: 2 @ $125; 1 @ $100 per mo.	
Labor, Laborers 2 men @ 40c per hour	7.61
Heat	.08
Light	.17
Misc. supplies and repairs	1.02
	20.30

Giving an operating cost of $20.30 per million gallons.

when the plant operates at full capacity or 3,000,000 gals. per day, our figures show that the cost will be as given in Table II.

During the year several improvements have been made in the lime dosage; a new slacking chamber was installed and the lime added further upstream from the electrolyzers, giving better slaking and mixing, also effecting a saving of approximately 25 per cent in the quantity of lime used.

Lately a new type electrolyzer was installed and tested out, showing a reduction of 50 per cent in the hydraulic head required, as well as an electrical efficiency considerably greater than the older type. This unit has the same effective electrode area as the older ones, but contains only a single row of 10 banks of electrodes, and the agitators reciprocate instead of rotate, being driven from the top instead of the side.

Comparison With Lime Process.

Comment has been frequently made that the Direct Oxidation process is no more efficient than lime alone. In this connection a great number of tests have been made at Allentown both by the City Chemist and by other investigators, and the results are conclusively in favor of the Direct Oxidation process, which gives an effluent that shows a greater reduction in

oxygen demand, oxygen consumed, organic nitrogen and bacteria.

These tests also showed that the effluent produced by lime treatment, even though practically sterile when discharged, will putrefy if mixed with river water, while that from the Direct Oxidation process will stand up indefinitely. When we consider the experience of the British Royal Commission, where litigation arising from nuisance has invariably followed from the installation of lime precipitating plants, and also the findings of the Massachusetts State Board of Health, these comments are untenable, for we have yet to encounter any nuisance at Allentown.

Conclusion.

A very significant feature about the operation of the Direct Oxidation process is that it is mechanical in nature and depends for its success, not upon the delicate adjustment of conditions in an endeavor so far as possible to favor the caprices of bacterial life, but solely upon simple mechanical contrivances whereby lime is fed into the sewage in sufficient quantities to render that sewage always slightly, but definitely caustic, and thereafter to maintain an uninterrupted charge of electric current in the electrolyzers. Outside of these features the process is automatic.

Except in the screen room, where the raw sewage passes over the screens, there is no odor of sewage, stability being obtained in the electrolyzing units without production.

No odors are present outside the building, even from the sludge beds. Fly and mosquito nuisances, such as are always prevalent at all other kinds of sewage disposal works, are unknown at the Allentown plant. A system of this type can be located at any part of the city where favorable delivery of the sewage can be accomplished, and especially where little space is available. Long expensive trunk lines and isolation of the plant is therefore unnecessary, a great saving in dollars to the municipality.

The plant operates irrespective of weather or temperature conditions, purification being accomplished without the aid of living organisms, and its operation is free from all uncertainties of bacterial activity; is not affected by climatic conditions or by changes in sewage, and is positive in action.

The variation in flow of sewage through the electrolyzers up to the capacity of the unit has no effect upon the current required. In other words, any quantity of sewage up to the capacity of the unit requires the same amount of current as the rated flow.

The foregoing paper by Mr. Bascom was presented at the recent annual meeting of the American Society for Municipal Improvements.

HOW GOOD ROADS DEVELOPED POLK COUNTY, FLORIDA

Possibly no county in the United States originally was more handicapped on account of its roads than was Polk County, Florida, seven years ago. To understand Polk County's predicament a brief explanation may not be amiss.

The county lies almost exactly in the center of the Florida peninsula at a point between one and three hundred feet above sea level. In topography it is a section of rolling hills quite sharply accentuated along the "Ridge" and at Lakeland Highlands, but sloping away toward the southwest into vast stretches of flat pine lands. Its soil includes everything from rich black muck to almost pure sand, though in the main it consists of various degrees of sandy loam. The county has about 600 fresh-water lakes of varying sizes, but they are useless for transportation purposes because they are disconnected, though kept fresh by subterranean streams.

Polk County is an agricultural county. It includes within its borders many towns —about 40 in all—the largest of which (Lakeland) has a population of about 12,000 persons. The next largest city (Bartow), the county seat, has a population of 5,000. The total population of the county is about 44,000. The county ranks very high in per capita wealth and in realty values, and stands third in the amount of automobile license fees paid in the state, being surpassed only by two counties where there are large commercial centers.

Ther are definite reasons why an almost strictly agricultural community such as this holds a high place among the counties of Florida and they are to be found principally in its natural resources. In Polk County the finest Florida oranges and grapefruit are produced to the extent of 3,500,000 crates a year. This is two million crates more than any other county in Florida ships, and is about one-third of the state's entire production.

In truck crops and winter fruits, especially strawberries, Polk County stands third. In general farm crop production it heads the list of all counties in the state.

In Polk County, too, one-fifth of the world's phosphate is mined, while from surrounding districts is obtained 42 per cent of the total phosphate production. The phosphate mines in Polk County alone are valued at $19,000,000. Polk County's third great natural resource is its timber, there being vast stretches of pine forests especially.

The county's manufacturing industries are small and, for the most part, are dependent upon its main resources. They include the packing of fruits and vegetables and some canning and preserving. Iron and foundry companies, sawmills and lumber factories are also to be found.

In 1915 Polk County was still a wilderness and was sadly lacking in transportation facilities. Railroads there were, but they were operating only to the principal shipping points and the phosphate mines. There were few of them because development did not warrant more. Ten years ago the town of Lake Wales, for instance, had no railroads. Today it has two.

The problem of growing and marketing the fruits and vegetables was particularly trying because of their perishable character and the peculiar natural difficulties encountered with the sand roads. Older settlers amuse themselves now telling how once it took a day to go from Lakeland to Bartow, a distance of 14 miles, and return. Now it requires but a half hour for the journey each way.

It was in 1915 that Polk County people began to realize that the rest of Florida was forging ahead of them and to grasp the reason why. The main streets of the larger towns contained the only pavements in the county. But the Board of County Commissioners that year took matters into its own hands and laid a couple of demonstration stretches of hard surfaced roads. In 1916 the Board requested and received a bond issue for road building amounting to one and one-half million dollars, the largest single bond issue ever requested for this purpose only in the South. Work progressed rapidly, and by 1919 the original road system of 217 miles, designed to connect every town in the county with every other one, was complete. The county has grown so rapidly since that time that in order to keep the new towns conected with each other by hard-surfaced roads there are now 346 miles of paved roads.

The new roads are of sheet asphalt surface laid on a clay base. To keep the cost down, local products were used almost exclusively in the construction work, the clay being taken from the Bartow clay pits and local soft phosphate rock being often used for the base. Coarse sand and fine Florida limestone for use in the filler happened to be readily available.

The new roads were laid on a clay base about 7 ins. thick. The surface was composed of a 2-in. asphalt sheeting. The roads are very smooth, and since they were laid with proper care as to drainage, are expected to last indefinitely. Since the roads were laid the repair bills have related only to some of the clay shoulders of the 9-ft. roads and, in a few rare instances, to lack of proper drainage in construction.

The new highways have now put the county in the forefront of the fruit and vegetable producing districts. Thousands of acres of new orchards and vegetable gardens, as well as general agricultural lands, have been opened to production, and the marketing of the county's products has not only been rendered more expeditious, but has been greatly reduced in cost. The people of Polk County are now numbered among the most enthusiastic advocates of good roads in the country.

SHOOTING WATER SUPPLY WELLS TO INCREASE THEIR CAPACITY

By W. G. Kirchoffer, Consulting Sanitary and Hydraulic Engineer, 22 N. Carroll Street, Madison, Wis.

The discharge of 20 to 30 lbs. of high explosives in deep wells in rock formations has been found to increase their capacities very materially. The explosives used consisted of 60 per cent dynamite and 60 per cent gelatin nitro glycerine dynamite. The charges generally consisted of 20 to 35 lbs., made up in a cartridge 4 to 6 ins. in diameter by 2 to 3 ft. long and exploded by No. 8 electric exploders.

These cartridges were placed in the wells at depths corresponding to the location of good water-bearing sandstones. Without a knowledge of the formations encountered in a well, shooting would be as likely to spoil a well as it would to improve it.

The first well to be shot was at Burlington, Wis. Here a well had been drilled to a depth of about 1,000 ft. The well yielded 274 gals. per minute, with a lowering of 36 ft.

The Common Council was not satisfied with the capacity of the well. It had been drilled without engineering advice, as one

alderman, who had much to say about the work, advised the other members that "an engineer knows a well only when he sees one."

The Mayor of the city took a hand in matters at this time and called in the writer to advise them what they could do to get more water. To drill deeper to the lower sandstone would have cost them $3,500, which they did not want to spend if it could be avoided. It was, therefore, arranged to have the driller shoot the well at a depth corresponding to the best water-bearing material. Two rather small shots were used, the well cleaned out and another test applied.

During this test 385 gals. per minute were pumped, with a lowering of only 30 ft. The shooting of the well increased the specific capacity of the well from 7.6 gals. per minute per foot of lowering to 12.8 gals. per minute per foot of lowering, or an increase of 68½ per cent.

At the Central State Hospital, Waupun, Wis., an 800 ft. well had been supplying 40 gals. per minute, with a lowering of 100 ft. Four shots were discharged at the location of the best water-bearing rock, and now the new air lift pump raises from 110 to 120 gals. per minute, with a lowering of 12 to 15 ft. The increase in capacity in this case was nearly 1,000 per cent.

Since these two experiences, wells have been shot at the Reformatory, Green Bay; Wisconsin State Prison, Waupun; Southern Wisconsin Home at Union Grove; Viroqua city well, Sauk County Farm, Reedsburg and the city wells at the same place; Cedarburg, city well, and at Clinton Jct., Wis. At all of these places the increased capacity of the well, after shooting, was very marked.

At Clinton Jct., where they had for years been pumping 120 gals. per minute from a 155 ft. level, they now pump 175 to 210 gals. per minute from a 55 ft. level. Three shots raised the water level over 40 ft., besides increasing the capacity.

Some drillers, engineers and air lift pump salesmen claim that shooting does no good and that there is as much danger of losing the water as there is in gaining capacity and head.

At none of these wells was there any capacity lost. At Cedarburg, the only one, the water level after shooting was about 20 ft. lower than before shooting.

A test before shooting showed a capacity of 165 gals. per minute, with a lowering of 44 ft. after shooting a capacity of 220 gals. per minute, with a lowering of only 12 ft., although the water stood higher in the well before shooting, the pumping level at 165 gals. per minute was 56 ft., whereas after shooting the pumping level at 220 gals. per minute was only 44 ft. The specific capacity increased from 3.73 gals. to 18.33 gals., and the energy required to pump a gallon of water decreased 18.6 per cent.

It is very evident in this case that, although the shooting lowered the static level of the water in the well, it did greatly increase the capacity and decrease the cost of pumping. The cause for the loss of head may be due to one or more effects of the shots. This well is cased to a depth of 718 ft. It may be that the jar of the blasts loosened the joint between the casing and the rock and allowed the water to escape into the upper formations, or it may be that the blasts hapepned to be discharged at levels where the water pressure in the rock was not a maximum, and therefore, with the greater space and surface of rock, allowed the pressure from the strata not disturbed to dissipate itself in the space left by the blasts.

To shoot existing wells at levels where there is non-water-bearing limestones or shales would be hazardous and uncertain.

It is not claimed that shooting would improve cased wells in other formations than water-bearing rock, or that such treatment would do other than destroy screened wells, but it is claimed that the opening up of a large space in water-bearing sand rock increased the capacity for two reasons:

First, it decreased the ground resistance to flow into the well by cutting away the rock adjacent to the relatively small hole and thus reduces resistance to flow.

Second, it makes the opening through which the water has to flow much larger, and thus reduces the resistance to the flow of the water up through the well.

Everyone familiar with wells will admit that a large diameter well will yield more water with the same amount of lowering than a small well will. By shooting we are only making a big well where we need it.

The shooting of these wells under the writer's direction has not only given greater capacity, but has materially reduced the cost of pumping by making it possible to pump a larger quantity of water with a smaller lift.

In a recent article by a representative of one of the big powder companies I noted that he advocated the use of very large cartridges containing 200 lbs. or more of

explosives. From our experience it would appear that several medium-sized charges are preferable to one very large one, as he advocates. Small charges of 1 or 2 lbs. of 40 per cent dynamite are practically useless.

To be successful, the cartridges must be carefully made and loaded with fresh materials and good reliable exploders. They must be properly protected from the water and kept as warm as possible to be really effective. The debris from the shot should be cleaned out to the bottom of the water-bearing formation, but not necessarily to the bottom of the well if drilling was continued into non-water-bearing formations.

RECOMMENDED REGULATION OF MOTOR TRAFFIC AND TRANSPORTATION

(Editor's Note.—The full text of the annual report of the Committee on Traffic and Transportation of the American Society for Municipal Improvements is presented herewith. It contains much matter of interest to public officials charged with the responsibility of drafting regulatory measures for motor traffic and transportation. A. H. Blanchard, Ann Arbor, Mich., is Chairman of the committee and Robert Hoffman of Cleveland, Ohio, and Charles O. Boyd of Beckley, W. Va., are the other members.)

This report is devoted to tentative recommendations which the Committee requested be discussed at the 1922 Convention, and also asked that those interested in efficient traffic regulation and the economic development of highway transport submit criticisms and suggestions relative to the several subjects presented herewith to the Chairman of the Committee prior to July 1, 1923, as it is the intention of the Committee to present recommendations relative to these subjects for final adoption at the 1923 Convention.

Weights and Dimensions of Motor Trucks.

Members of the Society are urged to discuss with the members of their State Legislatures the following dimension and weight regulations for motor trucks with a view to incorporating sane regulations in state laws which would be effective in all cities within a state passing such legislation:

Maximum width of motor truck chassis or body, 96 ins.

Maximum overall height from base of tire to highest point of vehicle or load, 12 ft. 6 ins.

Maximum overall length of vehicle, body and load, 30 ft.

Maximum weight per linear inch of width of solid rubber tires, measured at the base of the rubber, 800 lbs.

Maximum gross weight on one axle, 22,000 lbs.

Maximum gross weight of motor truck and load, 28,000 lbs.

In its 1923 report the Committee intends to present recommendations pertaining to trailers and maximum speeds for motor trucks and trailers operating within cities on different classes of streets for different types of motor trucks and trailers.

Financing of the Reconstruction of Streets

The Committee submits the proposal that the cost of reconstructing pavements and foundations on streets in business districts and main through trunk thoroughfares be financed by general appropriations and not, in cases of such streets, by assessment against abutting property.

License Fees for Motor Vehicles.

The Committee asks criticisms of the following tentative conclusion: That no license fees be charged for the operation or ownership of motor vehicles by any city, but that all such license fees should be collected by the State, and that a certain proportion thereof should be distributed to the cities by the State and be credited to the street maintenance funds.

Franchises for Freight and Passenger Highway Transport Inter-City and Rural Express Companies.

The Committee tentatively recommends that each highway trausport company operating an express, freight or passenger service on a definite route and in accordance with a time schedule should be required to obtain a franchise from a State Commision, particularly appointed for this purpose, and should be required to secure the permission of all cities through which it operates to use a definitely prescribed route therein.

Sign Posting for Through Routes in Municipalities.

The Committee suggests that at all corners at which turns are made on through routes in municipalities, direction signs be erected, and at the city limit on each route a large map sign be erected which will show the plan of all through routes in the municipality, giving the names of the streets and the principal adjoining cities to which each route leads.

Safety Car-Stop Zones.

The Committee tentatively recommends that raised car-stop safety zones be universally employed in place of safety zones

designated by limit lines, stanchions or mushrooms. The Committee also recommends that no stopping, ranking or parking be allowed at the curb opposite the safety zones, and for a distance of 10 feet each side of the safety zones.

Railroad Grade Crossings Within Municipalities.

Railroad grade crossings are a constant source of accidents. It is evident that their total elimination is desirable, but unfortunately is not practicable in all cases in the present state of the financing of highway improvements. Much can be done by proper design to reduce traffic hazards in the case of railroads crossing highways at grade. A clear sight of the railroad crossing for 500 ft. on each side materially reduces accidents, and a clear sight of the railroad for 1,000 ft. on each side of the highway is desirable. The width of all roadways crossing railroads should be at least 20 ft. For a distance of 100 ft. on eaeh side of the railroad the grade of the highway should be level or not over 2 ft. rise or fall in 100 ft. The suggestion by some officials to construct humps in the highway to slow down traffic approaching railroad crossings is unreservedly characterized as pernicious.

Proper danger signs should be located at 200 ft. each side of grade crossings in municipalities, and in sections which are poorly lighted at night a large electrically lighted rectangular sign carrying the word "Danger" in red letters should be suspended directly over the center of the street at the grade crossing.

Traffic Regulations for Municipalities.

The Committee recommends the adoption, as for as practicable, of uniform traffic regulations for vehicles and pedestrians in municipalities. It is the intention of the Committee to present a complete set of fundamental regulations in its 1923 Report. In this report there is included only regulations relative to which there may be differences of opinion. It is requested that those interested discuss these regulations with the Chief of Police of the city in which they reside and submit suggestions and criticisms to the Chairman of the Committee prior to July 1, 1923.

Vehicular Traffic Regulations.

No person shall operate an automobile, motor cycle or other motor vehicle on any street or public highway in the business or public highway in the business portion of the municipality at a greater rate of speed than 15 miles an hour, or on any boulevard, drive or parkway at a greater rate of speed than 15 miles an hour, provided such parkway or boulevard drive shall have signs placed at the entrance thereof to indicate such rate of speed, or on any street or public highway elsewhere in the municipality at a greater rate of speed than 20 miles an hour.

Vehicles turning to the left into another street shall pass to the right of and beyond the center of street intersections before turning, and in congested districts, where traffic policemen are stationed at street intersections, an approaching automobile or vehicle shall signal the officer, and shall not pass such officer until receiving proper signal from said officer.

Any person or persons operating or driving any motor vehicle or other vehicle shall, at the intersection of any public street or highway, within the limits of the municipality, keep to the right of the intersection of the center of such street or highway when turning to the right of such intersection.

When vehicles approach an intersection of two or more public streets or highways the vehicle approaching from the right of the driver shall have the right of way.

No vehicle shall turn to proceed in the opposite direction except at street intersections.

A vehicle shall not stop on a cross-walk nor within the intersection of two or more roadways.

No vehicle shall stop on any street except within 1 ft. of the curb, or in such way as to obstruct free passage on the street, provided that this rule shall not apply when a driver of a vehicle is compelled to stop for a standing street car.

Drivers of motor vehicles before starting, turning, stopping, backing or changing their course, hall make sure that such movement can be made with safety, and shall give definite visible signal of such intention.

No vehicle shall stop anywhere in the city with its left side to the curb.

Each bicycle shall be equipped with a suitable horn or bell for giving warning or signal of its approach, and during the hours when lights on the streets are lighted shall be equipped with a suitable head light.

The Chief of Polce may, from time to time, prohibit or regulate the stopping, ranking or parking of motor vehicles or other vehicles in any district where such stopping, ranking or parking will interfere with traffic or the public safety, and no vehicle shall be parked at any time within 15 feet of any fire hydrant.

Not more than two persons shall occupy the front or driver's seat of an automobile, except that a child less than 10 years of age may occupy the front or driver's seat as a third person, and no person, adult or minor, shall be seated in the lap of the driver, nor shall the driver be seated in the lap of a person when the automobile is in motion.

No motor vehicle having an over-all length greater than 20 ft. shall be diagonally or perpendicularly parked at a street curb except when loading or unloading.

Pedestrian Traffic Regulations.

Except where safety zones are established pedestrians shall stand on the sidewalk while waiting for street cars until the street car is within 200 ft. or less from the stopping place, and when alighting from street cars pedestrians shall not stand in the street, but shall proceed immediately to the sidewalk to the right, except where safety zones are provided.

Pedestrians crossing the street in the walk and not from between or back of vehicles in crossing a street without looking in both directions to see approaching vehicles, and shall cross only at right angles with the street.

It shall be the duty of all pedestrians to observe the line of traffic at street intersections and to obey the signal of policemen who are directing the movement of such traffic, and they shall not cross before the signal is given for the traffic to move in the direction toward which the pedestrians are crossing.

Pedestrians shall not cross street intersections diagonally, but they shall cross only one street at a time, using a crosswalk, if designated, or otherwise shall cross at right angles with the street.

Pedestrians crossing the street in the congested district or the business district or crossing any main thoroughfare, shall do so only at street intersections or crosswalks. Pedestrians crossing any street at a point other than a street intersection or cross-walk outside of the congested district or business district or main thoroughfares shall exercise due diligence for their own protection and safety.

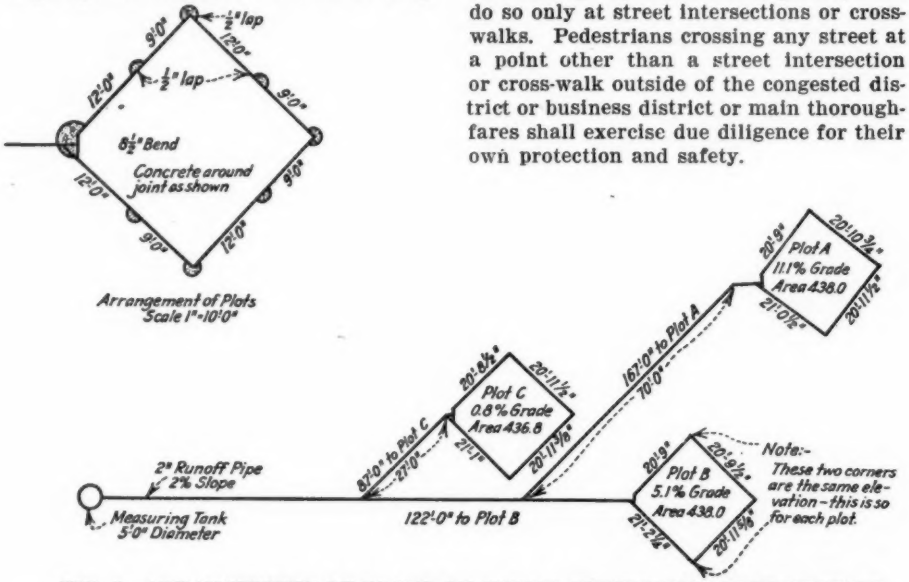


FIG. 1—ARRANGEMENT OF PLOTS ON WHICH SPRINKLING EXPERIMENTS WERE MADE TO DETERMINE RUNOFF AT WASHINGTON UNIVERSITY, ST. LOUIS, MO.

RAINFALL AND RUNOFF STUDIES IN ST. LOUIS; SPRINKLING EXPERIMENTS AT WASHINGTON UNIVERSITY

W. W. Horner, Chief Engineer, Sewers and Paving, City Hall, St. Louis, Mo.

Upon the examination of Volume 8 of the Technical Reports of the Miami Conservancy District the writer became very much interested in the sprinkling experiments described therein. They were carefully studied in an attempt to make use of the results in connection with the rainfall and sewer gauging research which the city of St. Louis has been carrying out.

The experiments, of course, have not been made for use in this connection, and the soil conditions in the Miami Valley were evidently so different from those in the vicinity of St. Louis that the attempt to use these results appeared futile.

This type of experiments, however, contained so many possibilities that it was decided to carry on a similar work in St. Louis under conditions more directly useful in sewer design. The writer secured the interest and co-operation of Prof. J. L. Van Ornum, head of the Civil Engineering Department of Washington University, and an arrangement was finally worked out for the carrying on of this experimental work through co-operation of the university and the engineering department of the city of St. Louis.

The first work was done under Prof. Van Ornum's direction as thesis work for senior students and has been carried on and extended by the engineers of the city during the summer period.

Scope of Experiments

It was decided to carry out the experiments on (a) typical soil conditions as found on the university campus; (b) for both bare soil and sod covering; (c) for three different slopes of surface; (d) for the rates of rainfall commonly considered in municipal sewer design.

Figure I herewith shows the plan of the site. Each bed has an area of 1/100 of an acre and the surface slopes as follows: Plot A, 11%; Plot B, 5%; Plot C, 8/100%. Each plot was carefully separated from the surrounding soil with iron plates driven through the top soil into the solid clay, the strips extending above the ground about 3 ins. At the lower corner of each plot an outlet was furnished into a 2 in. pipe and all drain pipes lead to a measuring tank set below the grade of the plots. In each plot the existing sod and vegetation was skinned off with as little disturbance of the natural soil as possible. The top soil consisted of a clay loam about 10 ins. in depth on the two steeper plots and about 15 ins. on the flat plot. This was underlaid by yellow clay.

Water was supplied through a water meter to three hoses; two of the hoses applied water to the plot through "Cactus" lawn sprinklers, and the third was equipped with a fine spray nozzle and was used in applying water to the corners not reached by the sprinklers. In this way the distribution of water was fairly uniform.

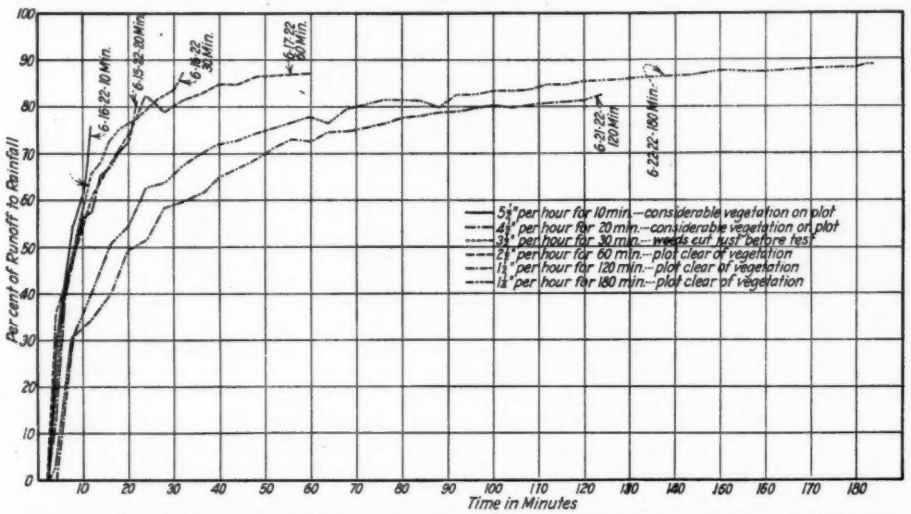

Per cent of Runoff to Rainfall
Time in Minutes
6-16-22-10 Min.
6-15-22-20 Min.
6-16-22-30 Min.
6-17-22-60 Min.
6-21-22-120 Min.
6-22-22-180 Min.
5½" per hour for 10 min.—considerable vegetation on plot
4½" per hour for 20 min.—considerable vegetation on plot
3½" per hour for 30 min.—weeds cut just before test
2½" per hour for 60 min.—plot clear of vegetation
1½" per hour for 120 min.—plot clear of vegetation
1¼" per hour for 180 min.—plot clear of vegetation

FIG. 2—RESULTS OF TYPICAL EXPERIMENTS TO DETERMINE RELATION OF RUNOFF TO RAINFALL.

Operation

In the operation of the experiments the sprinklers and nozzle were placed outside of the plot and the valve at the water meter regulated until the discharge reached the desired rate. All outlets were then removed to one of the beds and the experiments started. The water meter was read every two minutes during the heavy rates and every four minutes during the longer runs. Slight adjustments of the regulating valve were made from time to time to keep the rate constant. The discharge or runoff was determined by reading a hook gauge in the measuring tank which had previously been carefully calibrated.

Rates of Application

Rates of application were worked out from the rainfall curve for St. Louis and were taken off for each of the critical

times commonly used in sewer design. These were as follows:

5½ inches per hour for 10 minutes.
4½ inches per hour for 20 minutes.
3½ inches per hour for 30 minutes.
2½ inches per hour for 60 minutes.
1½ inches per hour for 120 minutes.
1¼ inches per hour for 180 minutes.

Soil Samples

Soil samples to determine the moisture content were taken inside of plot at depths of 3 and 12 ins., both before and after the experiments. It soon developed, however, that the absorption was comparatively small and that the saturation never extended to the 3 in. depth. For this reason soil moisture tests were of little value and were merely continued as an index of the soil condition during each run.

Experiments to Date

Three separate runs at each rate of precipitation have now been made on Plots A and B. One complete set and some portions of the second set are available for Plot C. Some additional runs will be made on Plot C after which all three plots will be sodded and will lie over the winter in preparation for the experiments on sod plots next spring.

Results Obtained

The results obtained were recorded in the form shown in Table I. From this form each experiment was plotted on the diagram shown in Fig. 2. On this diagram each line represents an experiment. Each point on the line gives the average percentage of run off up to the time shown on the bottom of the diagram. It will be noted that in each line the last point, or in some instances two points, show a sudden upward trend. These points are taken after application has ceased and represents the maximum rate of runoff which usually occurs from two to four minutes after the end of the rain. As will appear from the record sheets, this results from determining the runoff for a period equal to the period of application and by ignoring the first few minutes in which no runoff occurred, and adding instead the few minutes after the rain during which the runoff still persists. In discussing this later, these higher rates of runoff are referred to as the maximum, while the runoff at the

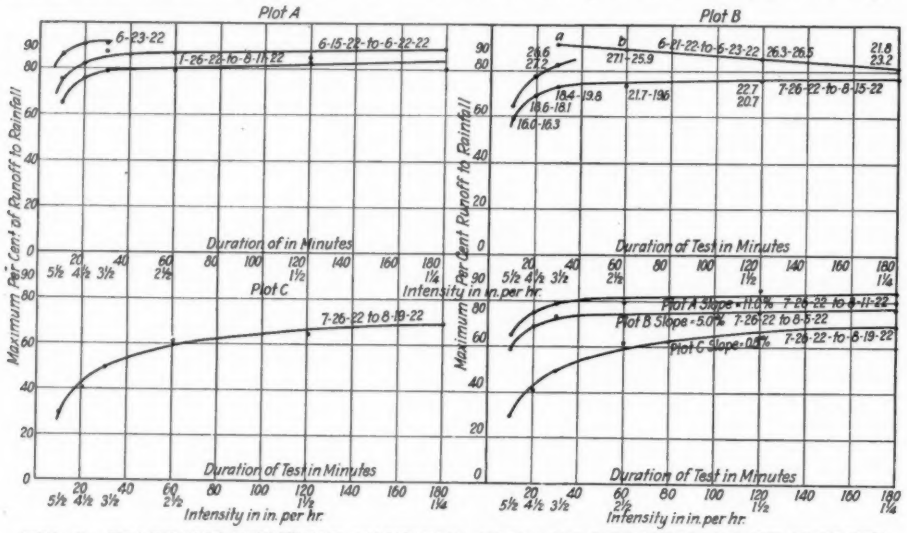


FIG. 3—DIAGRAMS SHOWING MAXIMUM AVERAGE PERCENTAGE OF RUNOFF FOR PERIOD EQUAL TO DURATION OF RAINFALL.

TABLE I.

Plot "A" Grade 11.0%
June 15, 1922

Clear. 4½-in. per hour for 20 min. Ar. soil moisture: 3-in. below, 17.5%; 12-in. below, 19.6%.

Time Min.	Hook Gauge Read. ft.	Vol. Tank from Curve cu. ft.	Runoff Dif. of Vol. Tank cu. ft.	Rainfall Meter Read. cu. ft.	Pctge. Runoff to Rainfall
0	11.865	10.3	0.0	0.0	0.0
2	11.865	10.3	0.0	5.5	0.0
4	11.770	12.0	1.7	11.7	14.5
6	11.555	16.3	6.0	15.3	39.2
8	11.352	20.2	9.9	20.7	47.8
10	11.175	23.8	13.5	24.0	56.3
12	10.976	27.3	17.0	29.7	57.5
14	10.750	32.2	21.9	33.5	65.4
16	10.520	36.4	26.1	38.8	67.3
18	10.261	41.9	31.6	44.7	70.7
20	10.000	47.0	36.7	50.4	72.3
22	9.778	51.4	41.1		81.5
24	9.743	51.5	39.5		78.4

end of the rain is called the simultaneous runoff.

While the shape of the lines in Fig. 2 is of considerable interest, the particular points are the end points of each line which represent the maximum average percentage of runoff for a period equal to the duration of the rainfall.

For each of the plots there have been prepared curves for these maximum points. The curves for Plot A are shown in Fig. 3. In this figure each point represents the percentage of runoff resulting from a rain of the duration corresponding and of the intensities corresponding to the duration. It will be noted that for a particular series of experiments covering all durations under a fairly constant condition of soil, points can be connected by a smooth curve. This curve shows that the percentage of runoff would increase with the duration of the rain, the

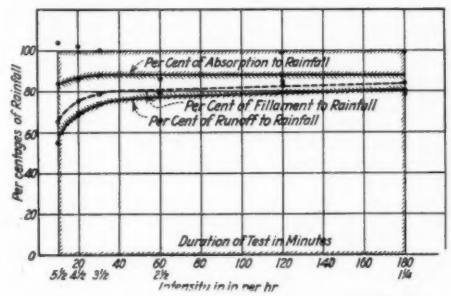


FIG. 4—RESULTS OF TYPICAL SERIES OF EXPERIMENTS ON ONE BED.

rates of rainfall being the critical rates corresponding to each duration as tabulated above. The change in percentage is quite marked during the first 30 to 60 minutes and is comparatively slight thereafter.

While the extent of this article does not permit of including the necessary data, it also developed that the percentage of runoff was effected quite remarkably by very slight changes in the condition of the surface soil. As an example, the lower curve on Fig. 3 for both Plots A and B represents a run which was taken just after a slight growth of weeds had been removed from the bed. The removal of the weeds disturbed the soil for a depth of ½ to ¼ in. and the difference between the lower and upper curves is largely explained by this surface disturbance.

The effect of absorption by the first 3 ins. of soil made little apparent difference in the results, but continued application of water, for each run, raised the moisture content for a depth of 12 ins., or more, and had quite a marked effect in increasing the percentage of runoff. For instance, on the diagram for Plot B, in Fig. 3, the experiments of the series represented by the lower curve were taken in order beginning with the short rains at intervals of one to four days between runs. As a result of this order the greatest application of water occurred on the last run, that is, on the three hour duration. On the upper curve of this plot the order of runs was reversed, the three hour being taken first, and then the two, one, and one-half hour runs. As a result the soil moisture was increased to a considerable depth and was increased from run to run, producing the remarkable high percentage of runoff shown at points a and b. The small figures opposite each point represent the average soil moisture in percentage of the dry soil weight at depths of 3 and 12 ins. in the bed, the contained moisture at a depth of 3 ins. varied little during these runs.

The effect of surface slope on the percentage of runoff is shown in the lower righthand corner of Fig. 3 where the diagrams for Plot A, B and C for similar soil conditions are reproduced together. While the difference in runoff rates between the 0.8% and 5% grade is very large, the examination of the points of the other diagram in this figure indicate that almost as great a variation may result from a change in the porosity of the surface soil or from the variations in soil moisture. The factors in the last diagram referred too, however, may be used as representing the average percentage of runoff with slopes given from rain falling on the bare soil during the summer months.

Diagrams in Fig. 3 represent results desired for use in sewer design. As a matter of academic interest, however, it was decided to make a further analysis of the data to determine the reasons for some of the variations in percentage of runoff. For this purpose the results were replotted in terms of rainfall volume as compared with runoff volume. The resulting curves are not reproduced here, but the following description of the analysis may be of interest.

It was found that the relation between total rainfall and runoff for each experiment could be represented with a fair degree of accuracy by a straight line. From this line two factors developed. First the intercept of the line on the

rainfall axis gives the amount of water in cubic feet necessary to produce a normal surface film, and second the slope of the line indicates the rate of absorption (and possible evaporation) during the run. The two figures, of the volume of water required to produce a surface film, and the volume lost by absorption, were then divided by the amount of water applied, and the results are taken to represent the percentage of rainfall required for the surface film and the percentage of rainfall lost through absorption. These results were then checked against the percentage of runoff for the same experiment and were found to total out very closely to the required 100 per cent. As an example of this analysis, a typical series of experiments on one bed is reproduced in the diagram in Fig. 4. To the writer, this result is extremely interesting and indicates a possibility of using the data not only for bare soil where absorption is taking place, but for application to paved streets and other impermeable surfaces.

FIG. 5—VIEWS SHOWING SPRINKLING OF TEST PLOTS IN DETERMINING RELATION BETWEEN RAINFALL AND RUNOFF AT ST. LOUIS.

The data is also being analyzed to determine the effect of variation in the intensity of rainfall on the rate of absorption but the results are not sufficient complete for publication. It has become evident, however, that rate of absorption does increase with the increasing intensity of rainfall, but the variation is small and of little importance compared to other factors involved.

It is expected that a similar series of experiments will be carried out on sodded surfaces during the coming year, and from the two series it is hoped that there can be built up a percentage of runoff for average urban districts which can be used in connection with the analysis of the larger scale gaugings which have been taken on the St. Louis sewer system during the past ten years.

SECURING CO-OPERATION BETWEEN ENGINEER AND CONTRACTOR

By W. R. Neel, State Highway Engineer of Georgia, Atlanta, Ga.

In securing co-operation between the engineer and the contractor the first lesson to be learned by the engineer is that he is not only representing the owner, but that he is also representing the contractor. Fairness to these two parties is the engineer's job, said Mr. Neel in addressing a recent meeting of the Southern District of The Asphalt Association at Atlanta. He continued:

First, it must be recognized that the owner or beneficiary should pay the full cost agreed upon for the improvement. The second, that the contractor effecting the improvement should receive a fair compensation for his efforts, insofar as the limitations of the contract will permit. It should be the desire of the engineer so to assist the contractor that after the proper execution of the work a maximum profit can be made. It should be the desire of the contractor so to perform his work that nothing, either in the spirit or the letter of the contract, remains to be done toward securing for the owner a satisfactory job. With both the engineer and the contractor entering into their work with this spirit, true co-operation may be expected.

The laws frequently prevent the very thing for which they are written. They frequently prevent the awarding of the contracts to the best bidder; frequently there are written upon the statute books maximum salaries to be paid engineers, thus preventing the state or county from securing the very best engineering service. Very often you find a resident engineer or a division engineer in charge of a great many construction jobs and clothed with full authority who may or may not be competent, and who frequently is paid less money than the foreman of the construction gang.

Contractors are always on the lookout for good men, and good men are always on the lookout for a means of bettering their positions in life; therefore, it is imperative not only from the interests of the owner, but also from that of the contractor, that adequate salaries be allowed in order to secure and hold competent, experienced engineers. Not only is this true of the engineer, but it is also true of the contractor. A well equipped contractor receiving a fair compensation for his work, with an experienced engineer (and generally this means an engineer receiving a fair salary) in charge of the work, means a smooth running, harmonious job where real co-operation and satisfactory results to the owner may be expected. On the contrary, a poorly equipped contractor who has submitted a bid which will not allow a first-class job with a fair margin of profit, means contentions, and either the slighting of the job or calling on the bondsman, and this always means delay and ultimately a poorly finished job and a dissatisfied public.

Unfortunately all engineers are not to be entrusted with the wide powers generally given the "engineer" by the specifications. There are in every profession what corresponds to the "shyster lawyers" —that is a man who lives by making trouble. Many men employing engineers think that trouble between the contractor and engineer is to be expected, and unless there is some trouble that the engineer is not looking after the job properly or is "in with the contractor." With this before them there are engineers who are unscrupulous enough to make constant trouble for the contractors; the result is loss to all contractors working under them or excessively high prices for work. The only remedy for this, in my opinion, is for reputable contractors to investigate the engineer in charge of work, and in case his reputation is not good to refuse to bid or work in his charge, and to inform the men who employ the engineer the reason for declining to bid. Bonding companies could be required by the contractors to furnish impartial information in regard to an engineer's standing and reputation.

Another cause of trouble is placing an inexperienced engineer in responsible charge of work. Owners will employ a graduate engineer just out of college. The man may be entirely sincere in his efforts, but through lack of knowledge of actual construction conditions he may by over-emphasis of some unimportant point cause a loss or at least unnecessary trouble without bettering the job in the slightest.

A phase of this subject which I consider a real serious one is the insistent bidding of contractors both poorly equipped and incompetent to perform a first-class job, but who can get bond. This class of bidder is a constant menace to the other contractors, as well as to the engineer's reputation. Of course you know how difficult it is for a public official to reject the bid of this class of contractor. In selecting any other than the lowest bid, the public official is immediately accused of partiality and even of graft.

The inspectors and the resident engineer are supposed to be able to enforce the carrying out of the plans and specifications and secure the same result regardless of what class of contractor is doing the work. Yet anyone at all familiar with construction knows how utterly impossible this is. To obtain first-class results experienced, well equipped contractors and competent, experienced engineers, and these co-operating to the best interests of the owner, are absolutely necessary. Now, how can this be accomplished? In my opinion the only practical way is for the engineer to reject all work not coming jam up to the plans and specifications.

If this is plainly understood, the result will be that contractors who are not equipped either with machinery or experience will either be deterred from bidding or very soon driven out of the contracting business. In order to carry out this plan successfully and with every assurance of fairness, specifications must be plainly written and competent engineers and inspectors placed in charge of the work.

CITY PLANNING BROADENS INTO REGIONAL PLANNING

By Nelson P. Lewis, In Charge of Physical Survey, Plan of New York and Its Environs, 130 E. Twenty-second Street, New York, N. Y.

(Editor's note: The following brief report was submitted by Mr. Lewis on behalf of the Committee on City Planning at the recent annual convention of the American Society for Municipal Improvements:)

There has heretofore been a disposition to confine city planning studies to very limited areas. This has been due in part to habit; those responsible for the planning have been accustomed to a restricted, not to say a parochial, attitude toward this subject. Nor was this unnatural, in view of the fact that the first attempts at what

was called "City Planning" in this country were almost wholly confined to a few high spots, such as the creation of civic centers, systems of boulevards, or something more or less spectacular, which would gratify local pride and have some advertising value for the town. In all cases the corporate limits of the city or town were the ultimate boundaries of the imagination of the planning authorities.

There was another reason for this contracted horizon, and that was the strict legal limitation of the jurisdiction of the local authorities within the red lines showing the city limits. There is now a realization that such restrictions are inconsistent with wise planning. The first attempts to extend the powers of local authorities were in the nature of prohibitions expressed as "thou shalt not," or the familiar "verboten." Owners of real estate, for instance, were told that they could not cut up their acreage into streets, blocks and lots and offer it for sale unless the plans for such sub-divisions should first have been approved by some designated authority, while offices of public record were forbidden to accept for filing any plans which did not bear evidence of such approval. At first such regulations applied only to property within the limits of specified cities, but this was soon followed by a long step forward in giving some municipalities similar control over the development of property outside of their boundaries, but contiguous thereto or within a certain number of miles. Progress in this direction was indicated in a report submitted by the writer at the last Convention of the Society. These steps indicated that those responsible for city planning were beginning to think in larger units. If it is desirable that a city should exercise some control over the development of property outside its limits, either within or without those of another jurisdiction, why should not the officials of contiguous or nearby towns sit down together and plan for their future development, or create some machinery by which such joint planning can be done? But there are legal limitations which make it difficult to accomplish anything in this way, and some of the most important planning projects yet undertaken have been the result of volunteer efforts by groups of individuals or quasi-public organizations, generally with, but sometimes, in their initial stages, without the sympathetic interest and co-operation of the municipal authorities.

In various parts of the United States there are groups of cities and towns whose interests are so closely related that it is impossible to plan for one of them without considering the others. Such a group includes Boston and about two score cities and towns within the district tributary to it. Many reports, some of exceptional value, have been made by special committees and commissions, looking to the comprehensive development of this entire district, yet nothing has been accomplished because there has been no machinery for the official adoption and execution of such plans. The Commonwealth of Massachusetts has created certain Metropolitan Boards and Commissions, lately combined in a single Metropolitan District Commission, having jurisdiction over the water supply, the main drainage, and the parks of the entire district, but when it comes to planning for the future development of the towns themselves and their relation to each other, where co-operation or joint action is especially needed, each community is left to go its own way without regard to what its neighbors are doing.

Buffalo has, by vote of its citizens, authorized the City Council to adopt plans for the location and grouping of the public buildings and a group of citizens, under the name of "The Buffalo City Planning Association, Inc.," is going much further than this and is studying Buffalo, not only as a city of well over half a million population, but as a part of the great Niagara Frontier District. This district affords an excellent opportunity for regional planning, involving even international problems, as the plans must necessarily include connections with the Canadian side of the Niagara River.

Early in the present year a Los Angeles County Regional Planning Conference was held, from which it appears that the progressive people of that county realize that, although Los Angeles has, by its various annexations, become the largest city territorially in the world, something more is needed to insure a consistent development of it and of the other cities and towns in this great county with respect to each other.

A persistent but unsuccessful effort to effect, by statute, a consolidation of a number of separate political units into one city was that to combine the towns on that east side of San Francisco Bay in Alameda County. These efforts, however, were, it is understood, confined to the attempt to make a single political unit, and whether, had it been successful, it would have been followed by the creation of machinery to

plan for the development of that unit, as a whole, cannot be stated.

Plan of New York and Environs.

By far the most comprehensive project of the kind which has yet been undertaken is "The Plan of New York and Its Environs," in which it is proposed to include an area of no less than 5,500 square miles, located in three states, with a population of approximately 9,000,000, according to the census of 1920. It will include, in addition to the present City of New York, with its five counties, five additional counties and portions of two others in New York State, eight counties and part of a ninth in New Jersey and a portion of one large county in Connecticut. The special difficulty and the delicacy of the problem is largely due to the fact that there are within the area under consideration nearly 400 different political units —states, counties, cities, towns, villages, boroughs and townships. No one municipal corporation could undertake the preparation of a plan for such an extensive area without arousing jealousies and the suspicion of imperialistic designs upon its smaller neighbors. It follows that a project of this magnitude can be undertaken only by an institution or a group of individuals who have no official connection with any of the political units which would be affected. The Trustees of the Russell Sage Foundation, which was established for the express purpose of "The Improvement of Social and Living Conditions," concluded that one of the most effective ways in which this object could be promoted would be through the preparation of a comprehensive plan for the future development of the district of which New York is the center. A Committee on Plan of New York and Its Environs was appointed under the Chairmanship of Mr. Charles D. Norton, who had been so successful as first Chairman of the Plan of Chicago in starting that great project on its way.

The first public announcement of the purpose of this committee was made at a meeting in New York City on May 10, 1922, at which some notable addresses were made, and Mr. Norton briefly outlined the work which had already been done and what the committee hoped and expected to accomplish. Very brief extracts from several of the addresses made on the occasion will indicate the reaction of the speakers to the proposed plan.

Mr. Herbert Hoover said: "The vision of the region around New York as a well planned location of millions of happy homes and a better working center of millions of men and women grasps the imagination. A definite plan for its accomplishment may be only an ideal. But a people without ideals degenerates—one with practical ideals is already upon the road to attain them."

Miss Lillian D. Wald said: "This seems to me a most important first step towards the most important undertaking that I have heard of for many years. I believe that if it is carried out in logical sequence it will add greatly to the happiness of the people of New York. It links a practical, workable plan with the vision of a city conceived in understanding of the needs of many people, their homes and those matters most closely related to their daily life."

As indicating the necessity of ignoring arbitrary political boundaries in making such a study, Mr. Elihu Root said: "A city is a growth. It is not the result of political decree or control. You may draw all the lines you please between counties and states, a city is a growth responding to forces not at all political, quite disregarding political lines. It is a growth like that of a crystal responding to forces inherent in the atoms that make it up."

There is probably no precedent for the manner in which the problem is being attacked "with a view," as Mr. Norton stated in his address, "to developing and recording those basic facts and fundamental considerations which are requisite to inform public opinion and to guide the future city planners."

The Physical Survey, which consists largely of an inventory, had already been started. This includes the mapping of existing topographical and other conditions, showing all trausportation facilities by rail, water and highway, parks and recreation spaces, public utilities already developed, such as water supply, main drainage, lighting, disposal of wastes, etc., public and quasi-public buildings, density and distribution of population, and whatever local schemes for improvement may be contemplated or in progress. All of this is to be supplemented by an Economic and Industrial Survey, containing an analysis of the fundamental reasons for the existence of this great center of industry and commerce and an inquiry into the economic and occupational activities that create populous districts and those that follow population. There is also a Legal Survey to include the study of existing laws in the several states, or their sub-divisions, which control or affect

a plan for the area, with an analysis of the laws governing zoning, excess condemnation, the stabilization of official city maps, shore rights and land under water; and finally there is also under way a survey of Social and Living Conditions, with studies designed to bring to the attention of those charged with the formulation of the ultimate plan, those factors which have a direct bearing upon human values and social welfare, and make for healthy and satisfactory home surroundings, efficient work and wholesome leisure time.

Serious Physical, Economic and Social Problems.

The great concentration of population about New York may be a source of pride to those who like to think and talk of it as the largest city in the world, but it involves many very serious physical, economic and social problems. In studying the past and probable future population the total area has been divided into three districts: (1), designated as the urban district and consisting of the present city of New York, with Hudson County and Newark in New Jersey, having an area of about 360 square miles; (2), the suburban district, including all of Nassau and Westchester Counties in New York, all of Union County, Essex County (outside of Newark), and portions of Passaic and Bergen Counties in New Jersey, and the eastern part of Fairfield County, Connecticut, having a combined area of about 1,170 square miles; (3), the remainder of the total area, comprising about 3,970 square miles, which is called the rural district.

The increases in population during the census periods since 1850 have been plotted for each of these districts and the curves projected forward to the end of the present century. From them it appears that the urban district, which in 1920 had a population of 6,700,000, will in 1960 contain 13,000,000, and in the year 2000, 20,000,000. The suburban district having 1,360,000 in 1920, will have 5,100,000 in 1960 and 13,000,000 at the end of the century. The rural district had some 940,000 population in 1920, and if its past rate of growth is continued it will have 1,900,000 in 1960 and 4,000,000 at the close of the century. The total population for the entire area at these different times is or is likely to be 9,000,000, 20,000,000 and 37,000,000 respectively. If these forecasts should be verified the average density of population in the urban and suburban districts combined would be equal to the present density in the Department of the Seine, but it makes a very great difference whether such density extends over an area of 1,530 square miles or over a restricted area of 185 square miles, which is that of the Department in which the city of Paris is located.

A recent and rather significant step has been taken in New York, where by an amendment of the State Constitution the Counties of Westchester and Nassau, both contiguous to the present city of New York and included in the area under study by the Committee on Plan of New York and Its Environs, have been given authority to change their form of county government. Commissions have been created to frame charters prescribing the manner in which the county business shall be conducted, and which presumably will provide some machinery for co-operation between the different towns and between them and the unincorporated places or the county itself looking to the future development of the territory as a whole. One of these charter commissions is known to be considering the question of a county zoning plan. Another recent piece of legislation empowered the local authorities, in these same two counties, to adopt zoning plans for the rural district outside of the incorporated places, this being an extension of the zoning idea which would have seemed quite improbable a few years ago.

This brief outline, describing a few of the things that have been attempted and that are being done, will indicate that the city planning horizon is being enlarged, and that when those responsible for such planning are considering the development of street or park system, the location and grouping of public buildings, transportation of passengers and freight by rail and water, or zoning, they are thinking in larger units, are losing sight of artificial political boundaries, or in other words, are trying to do Regional Planning.

PRESENT STATUS OF THE ACTIVATED SLUDGE PROCESS OF SEWAGE TREATMENT

By Langdon Pearse, Sanitary Engineer, The Sanitary District of Chicago, 910 So. Michigan Ave., Chicago, Ill.

Questions are frequently asked by engineers, as well as laymen, about the present status of the Activated Sludge Process of sewage treatment, and whether or not it is likely to cause a complete discard of the other known processes of sewage treatment. The purpose of this article is to outline briefly a general viewpoint of the process, indicating its adaptability and

TABLE 1—TYPICAL ANALYSIS OF SLUDGE.

Source of Sludge.	Per Cent on Dry Basis Nitrogen	Grease	Volatile	Fixed
Imhoff Tank				
Atlanta	1.37	4.8	34.1	65.9
Fitchburg ...	1.71	4.6	35.3	64.7
Batavia	2.93	3.1	47.0	53.0
Chemical Precipitation				
Worcester ...	1.62	1.2	41.8	58.2
Activated Sludge (Municipal Sewage)				
Milwaukee ..	5.82	2.2	67.8	32.2
Houston	4.64	7.1	62.9	37.1

Analyses made in laboratory of The Sanitary District of Chicago. Courtesy of H. P. Ramey, Acting Chief Engineer.

value, and outlining the points which appear to require further investigation. Further, the value of old tried processes, such as the intermittent sand filters or sprinkling filters for many situations, will be emphasized. The need of intensive study of the value of sludges for fertilizer and the encouragement of their use in agriculture will also be mentioned.

Ever since the art of sewage disposal became active in the early nineties the use of air for the purification of sewage has been very attractive, not only to the layman, but to the engineer. In the early days the tests applicable were not always accurate enough to indicate the changes made by simple aeration, but the facts stood out that in the presence of air biological purification went on vigorously though slowly under favorable conditions. Various experiments were made on the aeration of sewage by many observers, which culminated in the process now called the Activated Sludge Process, which holds the center of the field among processes for the direct aeration of sewage. The air used serves a double purpose, first, to provide sufficient oxygen in solution to keep alive the bacterial films and organisms which do the work of purification; and, second, to keep the particles in suspension thoroughly mixed with the liquid. The sludge is retained by settling and used over and over. When the system is in active operation, indications are that amounts of sludge may be removed from the system approximating the dry weight of the suspended matter in the raw sewage entering the system. Of the various sewage treatment processes available the Activated Sludge appears to produce a sludge with the highest nitrogen content and consequently the most likelihood of finding a market.

Observations of the existing activated

TABLE II—ACTIVATED SLUDGE PLANT—COMPARISON OF ESTIMATED COSTS.

City	Estimated Population For Operating Period	Sewage to be handled M. G. D.	Cost of Power per Kw. H. Cts.	Air in Cu. Ft. per Gallon	Annual Cost of Power for Air per Capita	Annual Cost of Power for Air per M. G.	Total Annual Cost per Capita	Total Annual Cost per M. G.	Remarks
Oklahoma City (1)	100,000	10.0	1.75	3.0	$1.85	$50.08	$3.31	$90.80	All Flow
		7.0	1.75	1.5	.75	28.60	1.78	70.00	Without Ind
Chicago, North Side.....	800,000	175.0	.85	1.25	.44	5.44	2.19	27.42	Waste
Urbana and Champaign	35,000		2.93	1.20	.65	24.70	1.70	65.10	
Houston (2)	100,000	7.8			.14	4.80			

(1) Power includes water for cooling blowers.
(2) Actual cost taken from published data combined for two plants.

TABLE III—COST OF SLUDGE PREPARATION—PER TON OF DRY MATERIAL.

	Based on tons per year	Pressing	Drying	Total
Chicago				
Packingtown (a)	28,800	5.72	2.45	8.17
North Side (b)	33,288			15.170
Houston (c)	422	38.00	25.90	63.90
Milwaukee (d)	34,901			11.97

Costs are estimated except for Houston.
Houston expects to materially reduce cost per ton.

(a) Pearse and Richardson. Estimated 1917. Based on coal at $1.75 per ton, No acid included.
Based on 96 tons daily for 300 days a year.
Overhead for superintendence not included.

(b) Eddy, Fuller and Hattton. Estimated 1922. Based on coal at $5.00 per ton. Overhead not included. Based on 365 days a year.

(c) Engineering News Record, 1922, July 27. Vol. 89, p. 132.
Based on raw sludge 422 tons per year.

(d) Approximate estimate, September 9, 1921, from 8th Annual Report Sewerage Commission of the City of Milwaukee, T. Chalkey Hatton, Chief Engineer. Coal at $5.00 per ton.

sludge plants and the various experimental stations indicate that of the various processes available, this seems to have the best promise of operating without nuisance. Trained observers visiting the larger plants in the South report almost unanimously corroborating this statement. The possibility of odors from the sludge handling has not been completely covered as yet by large scale work, but the indications are that this can be done inoffensively, either by lagooning or by filter pressing and drying.

In comparing the work of the Activated Sludge Process with other processes it is natural to take as a yard stick for thorough treatment the tried installation of tanks and sprinkling filters. The experience of the writer with experimental work on various trade wastes indicates that the sprinkling filter still has possibilities, and that it works along with varying loads with far less fluctuation in character of effluent and care in operation than the Activated Sludge Process. It seems to respond to increased load more readily, and to have a power for sustained effort, which indicates that it should still be considered as a valuable means of sewage treatment.

The character of effluent required has a bearing on the choice of process. However, of the various processes available for sewage treatment the activated sludge and tanks and sprinkling filters stand at the top for sizable installations. Intermittent sand filters are serviceable in small works. For sewage treatment generally the removal of suspended matter is usually important, and frequently the additional treatment to stabilize the organic matter, which can best be done by nitrification. High bacterial removals are seldom wanted except in special cases such as the discharge of effluent into the drinking water (Milwaukee). Chloride is very effective for such purposes as a finishing agent.

Two points which appear now to require investigation and further effort are the devices for introducing air, including the amount of air required, and the conditioning of the sludge. I speak of the sludge problem in this fashion because at the present time the difficulty in handling the sludge is not so much a matter of machinery as one of proper conditioning, so that the material will release its water readily. Pretreatment with acid and with heat has been serviceable in many cases. Various types of filter presses are available which will produce a cake with proper sludge. Considerable interest has been aroused by the ease with which thin cakes are formed on vacuum filters, such as the Oliver or American filters. Continued operating data on a working scale are required to settle the claims of various apparatus, and determine the relative value of each under all conditions.

Economies in the use of air may be produced as a result of the various experiments under way. Interest in mechanical aeration has revived in many types, but no very definite tests are available. The placing of the filtros plates eccentrically on the bottom is also being tried, with provision for vigorous overturning of the liquid (Chicago, Indianapolis). The limits of effectiveness are being studied, as it is essential to keep all the sludge in motion.

The problem which confronts many city officials in making a choice of processes is the annual cost thereof, including not only the cost of operation, but the interest and depreciation. This feature has an important bearing, where it is relatively easy to raise the larger sums of money by bond issues, and where the annual income by taxation or otherwise is limited upon the smaller installations; for instance, towns of 50,000 and under. Where the plant is

TABLE C—COST OF POWER.

City	Cents per k.w.h	Available for Activated Sludge Projects. Project or source.
Chicago	0.85	North Side, 1922
Chicago	0.7	Packingtown, 1917
Milwaukee	0.7	Stated in early report
Houston	0.6	Recent article
Indianapolis	1.0	Estimated cost of producing power
Sherman	1.75	

TABLE A.

Process.	First Cost.	Total Annual Cost.	Estimated Cost per Million Gal.
Tanks and Sprinkling Filters	$400,000	$46,800.00	$51.28
Activated Sludge	300,000	66,500.00	72.86

TABLE B.

Process.	First Cost.	Total Annual Cost.	Estimated Cost per Million Gal.
Tanks and Sprinkling Filters	$16,266,000	$1,766,000	$27.84
Activated Sludge with Drying	14,503,000	2,210,000	34.60
Activated Sludge with Lagooning	13,203,000	1,751,000	27.42

TABLE IV—SUMMARY OF ACTIVATED SLUDGE TESTS APRIL, 1920.

	Chicago Racine Ave.	Milwaukee	Cleveland	Brooklyn	Houston Act. Plant	Worcester	Urbana	New Haven	Pasadena	Baltimore	Brockton
Gals. per Cap. Daily	Industrial	322	160	102.5				180	50	100	84
Preliminary Treatment	20 or 30 Mesh	3/32 and ⅛	6		Bar Screen	Bar Screen ½	Vert. Bars ¾ Grit Chamber		Bar 0.5	1	40 mesh
Screen Open In.											
Aeration Tanks—											
Period Hrs.	7 to 13	4-6	1-3	0.5-72	2-4	3.8-6.5	4-6	2.7	4	24	2.8-4.6
Depth Ft.	11	15	15.08		9.5	10					16-91
Per Cent Sludge	19-58		15-25	10-30		17-35	12-24	8-.17.5	8-16	30	1.3-6.5
Air Cu. Ft. Gal.	3.27-6.52	1.25-1.5	0.75‡	0.1-30		2-5	1.6-3.1	1.3	1	0.67	2.2-5.3
Air Cu. Ft. per Sq. Ft. Min.	0.24-0.59		0.25			1.66-3.24	0.16-0.33		0.2		16
Filtros Perct. Tank Area	16	25-16	20		b23.3 c24.5	5.2-4	25	24	12		None
Reaeration Tanks		None	Sludge Reaeration Only in certain runs				None	None		None	
Period Hrs.	Aeration 4.9-7.1 Reaeration 3.3-4.4			0.5-3		o and 2.8-65			2-4		
Percent. Flow	65-92			5-30		17-35			40-50		
Settling Tanks				1. Imhoff 2. Hopper						Sed. compt. of Imhoff Tank	Hopper 1.1 slope
Type	Hopper 1.8 to 1 Hor.	Sq. Top Cir. Bott. Dorr Thick.	Horizontal Hopper 1.1 no good	1.1 no good 1.2 good 1.3 better	Hopper	Hopper 1.5-1 no good	Hopper	Hopper	Hopper		6′-10″ to base of cone
Depth Settling Ft.		15	27	3-2 5-7	21.5	9.6	11	12	13		
Depth Sludge Ft.		1.5-13	8-12	10-40 pct.		9					
Period Hrs.	1.1-2.2		0.5-1	0.25-12	1.8-3-6	c1.6-2.9	0.4-0.6	1.0	0.75	25	0.67-1.33
Gal. Sq. Ft. 24 Hrs.	575	1600-1800				607-1039	1000-2700		800		
Sludge—											
Lb. per Mil. Gals.	1916-2420 1917-1924	2000	1300	Variable			*740-1150		1390		
Percent. Moisture	99	95-99	97-99	98.5-99.5			*10		98-99.3		99
Percent. Sludge to Susp. Mat.	84-95								1-1.7		
Percent. N (Dry)	4.4		3.21				*4.5-5.7	3.2	5.8		
Effluent-Stability	Summer 75-95 Winter 20-30	120 hr.†	Clarification	†0-100			50-100				

a Could be shorter.
b Aeration tank.
c Reaeration tank.
* From exp. of 1915.
† The average result with 4 hr. aerating and 1 cu. ft. air per gal. of average sewage was about 85% stability; nitrites 0.6 p.p.m; nitrates 2.5 p.p.m. Moisture of sludge, 99%.

TABLE V—COMPARATIVE ANALYSES OF CRUDE SEWAGE—PARTS PER MILLION.

Constituent	Chicago 39th St. 1909-1912	Chicago Racine Ave. Day Night	Milwaukee 1917	Cleveland 1913	Brooklyn 26th Ward	Houston 1915 T. S.	Worcester 1917-1918	Urbana	New Haven East St.	Pasadena 1917	Baltimore	Stockton Screened
Nitrogen as—												
Org. N.	7.8	‡7.9	*40	8.5	27	5.5	8	°11.5-32	10.0	20		
Alb. Amm.			16.8					§2.4 7.2				8.6
Free Amm.	9.1	‡22	17.8	12	32	6.3 15	19	13-16	4.4	82	24	30.4
NO_2	0.10	‡0.49	0.10		0.26	Tr. 0		2.4 5.5				0.17
NO_3	0.33	‡3.04	0.04		0.00	Tr. 0.1		2.4 5.5		0.27		0.16
Oxy. Cons.	43	181	146	50	61	139 88	124.5	46-58	1.6	165	113	111.7
Chlorine	40	‡1100	238	254	35-50		102	§30-100	37	90	170	139
Alkalinity	212	‡291	256	137	200†			§350-460	695			
Total Solids.			1215		600-800		837	§700-1000	53	717		629
Susp. Mat.—												
Total	144	408-193	244	252	136-200	253-192	244	90-130	97	282	256	162
					Avg. 168				63			
Volatile	90	334		126	103-150		173					
					Avg. 129							
Fixed	54	74		130	39†		71		34			
Fats									10-15			
Iron		148-72		20			51.9		0.6-12.0			
Bio. Oxy. Dem.		960			223	103-176		220-260				

Exclusive of Sundays which are weaker than night. * Includes free ammonia. ° Analysis of 1915. § Analysis of 1906.

located in the outskirts beyond the built-up sections, the tank and sprinkling filter installation are likely to be the more expensive in first cost, but cheaper in annual cost. In a recent report for a group of towns aggregating 45,000 population the comparative costs in Table A were estimated by Pearse, Greeley and Hansen, the power being offered by the power company at 2.93 cents per k. w. hr.

In such installations the protection of large surrounding areas may not be so necessary as in the large installations which frequently have to be built right upon the outskirts of the city. As an interesting comparison, figures in Table B may be cited from a recent report made by the engineering commission composed of Messrs. Eddy, Fuller and Hatton on the North Side Treatment Works for the Sanitary District of Chicago, to handle the sewage of 800,000 people.

These costs include pumping station cost, but not any plant for generation of power, power being figured on a bought basis. Further, a belt of land half a mile wide around the site is included in the sprinkling filter project.

The column, "total annual cost," gives the annual cost, including interest, depreciation, maintenance and operation.

The preparation of the sludge in the small plant does not seem at present attractive unless in exceptional cases where local agricultural demands make a market; otherwise the cost of preparation may exceed, under present conditions, the value which can be obtained for the finished produce, screened, dried and bagged for market.

Particularly on large installations the offset to the annual cost is that the investment in intercepting sewers would materially be reduced by locating the plant at or near the source of the sewage. This is particularly valuable in relation to certain industrial problems which occasionally arise.

The cost of power is a very important item, inasmuch as in round figures around 12 h. p. are required per 1,000 population, with 200 gals. per 24 hours flow per capita. For the large plants low power costs are available, as for instance at Milwaukee, Chicago and Houston. In the smaller cities, where estimates have been made, power runs from 2 to 3c per K. W. hr., making a much higher annual charge. Until the power required is reduced this is an important item. (Table C.)

In the comparison of estimates, operating costs should be carefully scanned. In

a small city like Sherman, Texas, one man runs the plant. However, he lives nearby, and further has no sludge disposal to look after. On the other hand, where sludge disposal is contemplated, the overhead charges may be approximately the same in small plants for a range of tonnage produced. The cost of sludge preparation in the smaller plants may run high on account of the necessary overhead and small output. Costs will probably vary considerably with working conditions, and the market prices of labor and fuel, as shown by Table 3.

The value of the sludge is a question as yet which can only be settled through actual test over a series of years by agricultural experts skilled in comparing fertilizers. Apparently the sludge has enough nitrogen ordinarily to be of some value. At present freight rates the values contained apparently will not warrant long hauls. Under recent financial aod agricultural conditions low grade fertilizers have been a drug on the market. Such conditions, however, should prove temporary. In the meantime steps have been taken to interest various agricultural experiment stations in intensive study of the material. As a financial venture at the present time, the preparation of the sludge with a 5 per cent nitrogen content may cost more than the possible sale price today in many localities. Hence the recommendation of lagooning by Messrs. Eddy, Fuller and Hatton for the North Side project of the Sanitary District of Chicago as an immediate outlet for the sludge pending further developments.

A compilation of data on the various activated sludge plants in the United States may be of interest, though not entirely complete, as the small plants like San Marcos and Sherman, Texas, are omitted, as well as the industrial waste work of the Sanitary District on tanneries and corn products. (Tables 4 and 5). Some improvement is reported by Milwaukee over the operating data given in Table 4.

To sum up, the activated sludge process is a demonstrated fact, effecting a high grade of purification and producing a sludge higher in nitrogen than the average sedimentation sludge. In small cities of less than 50,000, where power costs are high, the annual cost may prove high. In larger cities and for special problems in industrial wastes, the annual cost may be considerably lower. Estimates and studies for particular localities alone will lead to a decision. With proper care and adequate design either the activated sludge process or the sprinkling filter should produce good results if not overloaded. The choice will depend on a thorough study of local conditions, not only of engineering, but of finance.

DESIGNING WATER DISTRIBUTION SYSTEM

By Eugene Schaub, C. E., Mem. Am. Soc. C. E., Logan, Utah.

While the author realizes the fact that the efficient design and arrangement of a water pipe distribution system requires much judgment and experience, besides knowledge of the fundamental principles of hydraulics pertaining to the flow of water in pipes, there are, at the same time, many methods in use to acquire a desired end.

One method is by means of visionary pressure contours when the entire system is assumed to be in action, or if the entire system is composed of several component parts, each part being considered in connection with the other parts under a synchronous action.

In addition to the effective arrangement and design of a system it is high time that valve and fire hydrant placing be standardized; also that a standard size nipple and nipple thread be adopted everywhere in the United States. The author has it from an authentic source that we have a great number of different kinds of fire hose nipples and hose nipple threads. This sort of a thing must be discouraged in the installation of fire hydrants if we expect to help one another effectively in the various communities in case of a serious fire. What I mean by this, is: One fire fighting crew with its equipment in one town should be able to make his equipment fit for help in the next or neighboring town. Many communities, under different charters, are built close together, and the author knows of some cases having 6½ threads and the adjacent village an 8-thread, a deplorable situation.

The premises upon which to conclude a design and arrangement are:

(1) Population density and probable maximum use.

(2) Contour map of the section or sections under consideration.

(3) Minimum pressures under a maximum demand.

Having the ground contour lines on the map in one color, we can place on this same map a set of contours in a different color representing the flow pressure plane

below the hydrostatic plane. The difference between the ground contour and the flow pressure plan contours is the effective pressure head. The difference between the flow pressure plane and the hydrostatic plane is the drop in pressure at any one point in question.

Starting at the lowest levels one must proportion his size of pipes in such a manner that his pressure contour planes will be elevated, as near as possible, a constant distance from the ground contour plane. The hydrostatic plane, of course, is one whose equation has a definite form, and whose position is well defined, as is the ground contour plane. The hydraulic plane, on the other hand, is one in which more or less uncertainty is always present. However, by careful study and conservative judgment in the design or selection of the various diameters, one will arrive at a plane whose plotted position will be a great aid in checking up on the probable future action of the system. This method is the graphics of the probable water action in a system of pipes under the assumed conditions. It is always better practice to design for a hydraulic plane higher than at first desired. Many have laid out a system without due regard to this hydraulic plane, and the result is that we have many systems in which our pressure is far below the desired minimum when the system is in action.

Proceeding upward from the lower levels with the hydraulic plane, we will at some point very nearly coincide with the hydrostatic plane, and would coincide if our mains from the source of supply were amply large. However, the segment between this limit and the hydrostatic plane is one of economics with respect to cost in pipe sizes. This approaching and limiting drop in pressure head near the source of supply must always be kept down to a small margin.

The fundamental expression for loss in head equals $K\left(\frac{v^2 l}{2gd}\right)$, the value of K, of course, depends upon the nature of the pipe interior. These values have been determined in a general way, and can be found by referring to the various authorities on this coefficient. This expression may be simplified for use in any one particular type of installation.

The author's experience in the installation of a system from the design is another important part of the work. The value of close inspection during the process of caulking the joints is one that cannot be over-estimated. There are a great many sloppy caulkers posing as efficient workers, and the best thing to do when one shows up to dispense with him.

The author has had a great amount of experience in designing water works systems. In the placing of valves and fire hydrants the following system has been adopted and put into effect whenever possible: Two valves at each street intersection, always placed on the property lines, one on the north and one on the west side. This, of course, is with respect to a rectangular layout. In an irregular layout of city property an arrangement of symmetry can be adopted by facing a definite objective and placing the first valve forward and thence turning counter-clock wise to the next street for the second valve. By adopting a definite system the work of the water department will be much simplified.

Next in order, and of equal importance, is placing the fire hydrant at a point where it is easily accessible in case of fire and where it has the most exposure to the sun. The author has adopted the southeast corner of each block as a standard placing, being set back 3 ft. from the street line. Placing the fire hydrants in a systematic manner will always enable the fire department to render most and quickest service. They know before hand just where a hydrant can be used.

The author has had considerable experience with respect to electrolytic action on water pipes due to stray direct current, and cautions that every known method be adopted to reduce this action to a minimum.

It is also extremely important that the water superintendent makes a periodical report, on a printed form supplied for this purpose, of the detailed inspection of every fire hydrant and valve. Each fire hydrant should be given a thorough test once every month and so reported. All inspection reports should be kept on file.

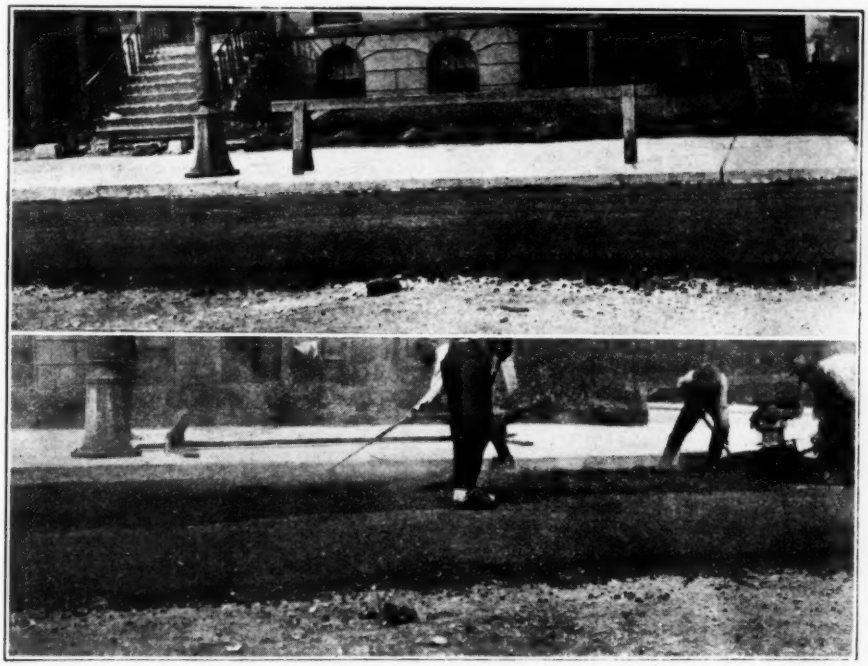
ASPHALTIC CONCRETE BASE USED IN REPAIRING PORTION OF WASHINGTON BOULEVARD, CHICAGO

By John B. Hittell, Mem. W. S. E., District Engineer, The Asphalt Association, 729 Hearst Bldg., Chicago, Ill.

Washington Boulevard, Chicago, from Halsted St. to Ogden Ave., under the jurisdiction of the West Chicago Park Commissioners, is being repaved with a standard 2-in. sheet asphalt wearing surface

upon an asphaltic concrete (black base) foundation. The roadway width is 48 ft. and the length 4,630 ft.; the sq. yardage approximates 26,000. The Commonwealth Improvement Company of Chicago, being the lowest bidder, secured the contract.

While nominally a boulevard, the layout of the street with its half or staggered intersections is such that heavy traffic will be permitted in going between intersecting outlets. There are 13 streets leading onto the boulevard at intervals of about 330 ft.



VIEWS SHOWING CONSTRUCTION OF ASPHALTIC CONCRETE BASE FOR SHEET ASPHALT PAVEMENT ON WASHINGTON BLVD., CHICAGO.
Left: Macadam Foundation and First Layer of Black Base Partially Rolled.
Right: Raking Second or Final Layer of Black Base.

from which unrestricted traffic will cross over or use the street to the next nearest intersection. Halsted St., the eastern terminus of the improvement, is only a mile and a quarter from Lake Michigan, and lies at the door of the West Side manufacturing district. Within the limits of the improvement the street has long since passed the state of a residential boulevard, and is fronted by many manufacturing or heavy trucking concerns. Among these may be mentioned the National Biscuit Co., United States Postoffice garage and the Chicago Machinery Exchange. These conditions, the general disturbance of the macadam foundation prior to the present paving operations, and a small increase in elevation of the new surface were among the reasons prompting the Commissioners in selecting a resilient instead of a rigid base for the wearing surface.

Mr. Wm. G. Barclay, Superintendent, West Chicago Park Commissioners, in speaking of the improvement, said:

"This part of Washington Boulevard was paved with asphalt in 1893 and some of the intersections were repaved in 1906.

"The areas of the numerous intersections, as well as those of parts of the roadway from which heavy or truck traffic cannot be barred owing to the fact that many of the interesecting streets do not continue in line across the roadway, summed up, are probably 50 per cent of the entire area, so that in effect the pavement will be subjected to a traffic similar to that on any business street nearby.

"The disturbance of the old macadam foundation was very general. One corporation made openings every 25 ft. along the street, and much rehabilitation work on underground services was necessary, due to the period of 29 years between the placing of the pavement in 1893 and this.

"The Commissioners, knowing that additional materials were needed to provide a proper foundation, carefully considered the merits of Portland cement concrete

and black base. Their investigations of the bituminous type of foundation in several cities and the opinion of the engineers experienced in pavement construction convinced them that the black base would be the better of the two. Being resilient, it absorbed some of the shock of impact of traffic, thus protecting both the wearing surface and the macadam base; that full contact would be had with the base and perfect bond with the wearing surface; the binder course could be eliminated, and that the work would progress more rapidly, as no time would be lost as in waiting for an hydraulic concrete base to cure, an important consideration at this time (Fall) of the year and the demands of traffic."

The placing of the black base involved no methods of construction differing from those commonly employed in laying binder. Where the depth of it was more than 3½ ins. the base was laid in two courses, as shown in the illustration.

Standard Mexican asphalt, produced by the Standard Oil Co. of New Jersey, is used in the asphaltic concrete base and wearing course, typical analyses of which are as follows:

Base.		Wearing Course.	
Bitumen	4.9	Bitumen	10.0%
Pass. 200 mesh	2.0	Pass. 200 mesh	12.3
Pass. 80 mesh	9.5	Pass. 80 mesh	29.9
Pass. 40 mesh	5.6	Pass. 40 mesh	37.7
Pass. 10 mesh	3.1	Pass. 10 mesh	10.1
Pass. 4 mesh	10.2		
Pass. ½ mesh	24.6	Pen AC	41
Pass. ¾ mesh	28.4		
Pass. 1 mesh	11.7		

For the West Chicago Park Commissioners Mr. William G. Barclay, Superintendent, has general charge, while William G. Keith, engineer; Thomas Newton, field engineer, and William A. Basse, inspector, are responsible for details of office and construction work. Messrs. Alexander Todd and Walter Leininger, constituting the Commonwealth Improvement Co., are giving particular attention to the construction, with William G. Foley as foreman in charge.

Walter H. Flood & Co. and the Chicago Paving Laboratory are acting, respectively, as chemical engineers for the contractor and commissioners.

TROUBLES EXPERIENCED IN MODERN METHODS OF GARBAGE DISPOSAL

By Samuel A. Greeley, of Pearse, Greeley & Hansen, Consulting Engineers, 39 W. Adams St., Chicago, Ill.

The practice of refuse collection and disposal in American municipalities has been characterized by some well informed observers as a mess of mistakes. They see a wide variety of disposal methods in use, and in some cities apparently abrupt changes from one method to another, sometimes involving the abandonment of seemingly useful and expensive going plants. They see large and costly disposal works built and operated for a few years and then abandoned to gradual disintegration. The city engineer of Gary writes that "our incinerators have been out of service for seven years and would have to be rebuilt to make them serviceable." Los Angeles, after seven years' operation of a garbage reduction plant, has abandoned it (at least for the present) in favor of hog feeding. Baltimore, after a few years of hog feeding for garbage disposal, has turned again to reduction; and Buffalo, with hog feeding established for a while, has recently taken bids for incineration. The large reduction plant at New York and a group of incinerators at Seattle have all been abandoned in favor of dumping at sea.

The critical observer further notes many different disposal methods in use in different cities, with reported satisfactory results. Thus at Minneapolis the garbage is burned with some rubbish, while in St. Paul it is taken to several farms for feeding to hogs. In the metropolitan district of New York, the Borough of Queens burns the garbage and rubbish; the Borough of Richmond burns mixed refuse; Manhattan and the Bronx dump the garbage at sea; Newark feeds the garbage to hogs. A short distance up the State, Schenectady, Rochester and Syracuse have reduction plants. These are situations which merit interest and consideration.

Fundamental Considerations.

Having these observations in mind, it becomes increasingly important to emphasize the fundamental considerations largely controlling the problem of refuse collection and disposal. If service to householders and proprietors be held of first importance, with economy of operation following closely, then the observer's perspective shows the disposal of refuse as of somewhat less importance than the collection service. If two somewhat similar cities (as for instance, St. Paul and Minneapolis) have equally good collection service, it is quite possible that general satisfaction among householders can be secured with different methods of disposal. If the different disposal methods are well administered, the difference between them is largely one of annual cost.

Therefore, at the risk of repetition, let

me state the four parts or phases of the refuse problem as follows:

a. The house treatment.
b. The collection.
c. The transportation or haul.
d. The final disposal.

Of these phases of the problem, the collection and transportation are the costly part of the work (on an annual basis). As the collection also orients or establishes the standard of service to houses, it merits first consideration in the development of a general plan. If the development of general plans for refuse disposal, or the readjustment of existing methods were oriented squarely to the relative importance of these various phases of the problem, the shifts and failures, which our informed observer finds, would not so frequently occur.

Let us note, however, that recent years have marked a promising realization of the importance of collection work and the related problem of haul. Much has been acomplished through motorization as at Los Angeles, Montclair, Minneapolis and elsewhere, although final economies are not yet established. Further progress toward economy has resulted through the use of the tractor-trailer and the establishment of transfer stations which permit the decrease of the expensive collection haul with an increase in cheaper quantity haul.

Importance of Haul.

Thus a review of refuse disposal practice in the light of some of the projects recently developed, particularly in the larger cities, reveals, among other things, a growing realization of the importance of haul. By haul is meant the travel of the loaded collection unit from the collection district in which the refuse is produced to the place of disposal. This item in fact links up the various phases of the refuse disposal problem from the house treatment to the final disposal. In plain terms the gradual exhaustion of dumping grounds and disposal sites and the increasing cost of haul have curtailed the collection service to such an extent that public opinion has come to the front for improved service. This is a situation which, if rightly turned, can greatly assist the development of improved service through acquirement of sites, overhauling of collection equipment and construction of disposal works. With increasing costs of haul old appropriations cannot continue the collection service desired, so that betterments and economies are requisite. If nearby dumps become filled, how can the old budget carry double or triple the haul without curtailing the service? This can only be accomplished by more economical methods, or by increased budgets, and often both are needed. Thus the haul becomes involved with the dump and the disposal plant, for oftentimes the method of disposal will increase or decrease the useful life of dumps.

Improved Operation of Dumps.

The dump, in my judgment, is likely to be a factor in the disposal of refuse in nearly all cities for many years to come. It should, therefore, be given much attention in operation and use. Of first importance is the sanitary maintenance. Efforts to secure a rat-proof dump are becoming more prevalent, so that garbage is taken less frequently to dumps. The 1920 New York Commission reached the general conclusion that not only garbage, but rubbish and street sweepings as well, should be kept off of dumps. This consideration was an element in the decision which has led Philadelphia to take bids recently on a large rubbish and garbage incinerator.

As related to the problem of increasing hauls and the contingent stretching of the budget, the life of the dump becomes important. This is a local problem involving the availability and extent of dumping areas and of other methods of disposal. Thus if mixed refuse (garbage, ashes and rubbish) is burned, the bulk to be dumped is reduced by 60 per cent or more. If the garbage is fed to hogs, only about one-third need be otherwise disposed of. The matter of available dumping grounds has become acute in many of the larger cities, including London and Chicago, as commented on below.

A Typical Condition.

In a typical large American city the refuse problem required the ultimate disposal of the following materials: Ashes, rubbish, garbage, manure, street refuse and trade refuse.

In the smaller cities garbage and rubbish assume a larger relative importance. These refuse materials are disposed of in a number of ways, of which the following are typical:

(a) Most of the street refuse and ashes, with much rubbish, is taken to dumps. Measured by quantity, by far the larger portion of a typical city's refuse is dumped.

(b) Manure (stable refuse) is mostly transferred to farms and truck gardens, but some of it frequently reaches the dumps.

(c) There is nearly always some sal-

vage, chiefly of rubbish. This is often done by scavaging dumps, but sometimes in specially built plants.

(d) Hotel and restaurant garbage is generally fed to hogs, or rendered for grease and tankage. Relatively inert trade refuse is dumped. Thus the accessibility of dumps (or loading stations) affects the cost of industrial output.

(e) A variety of special methods of disposal have been developed for garbage, sometimes with the admixture of rubbish, ashes and other refuse materials.

Thus, for a typical condition, we find disposal by dumping used for as much of the refuse as can be dumped without creating objectionable conditions, with special disposal works developed for the rest. There appears also to be in some cities a tendency to increase the proportion of refuse dumped either on land or at sea, sometimes resulting in the abandonment of the specially developed works.

The location and accessibility of dumping grounds is, however, a direct factor in the cost of collection and haul, and dumps gradually become permanently exhausted from refuse disposal. Cities should, therefore, give careful consideration to their dump resources, with particular reference to the collection service and to other matters of disposal which decrease the amount of refuse to be dumped.

A Yard Stick for Haul.

The matter of haul may, therefore, have a determining influence on the development of special methods of disposal and the conservation of dumps, and it is therefore necessary to set up a measure for the relative value of haul. Local conditions will largely make up such a yard stick, but the effect on collection service and cost is one of the chief factors. Some data on the rate of collection work is given in Table 1. As an average figure for a typical large city, let us assume that a collection unit of two men can make collections of house refuse at the rate of 75 pickups per hour. If the unloading point is so located as to require four hours of haul, each such collection unit will serve around 300 houses per working day. If the team haul be reduced to three hours, the number of pickups (or houses served) will be increased to 375 per day. Under some local conditions the team haul requires as much as five hours time.

In larger cities the team haul can be supplemented by quantity haul. If the team haul (averaged with collection service) costs $4.50 per ton, quantity haul may cost only a third time as much, or about $1.50 per ton. What then is the economical relation between team haul and quantity haul? Obviously this can only be determined after a careful study of all the local conditions, including the rate of collection work, the travel of teams and motors, the available locations for transfer stations, the life and location of dumps and disposal plants, rates of wages and other similar considerations. But the yard stick for haul is the number of houses to which collection service can be given by a unit of collection and haul equipment. With due regard to the life of disposal works and to sanitary conditions, the work of collection and haul should be planned to serve the maximum number of houses per day.

London Reports.

During the last 5 or 6 years the refuse disposal of the Administrative County of London has called for special study largely through increasing costs of haul. From a population of almost four and one-half million it is estimated that about 5,000 tons of refuse per day require disposal. The county is divided into 28 metropolitan boroughs and the city of London, making 29 divisions in all. The following figures show the proportions in which the various methods of disposal are used:

Method of Disposal.	Number Borough.	Percentage of Refuse by Weight.
Barges to Dump.....	22	44.66
River to Dump.....	13	16.66
Incineration	14	18.66
Other Methods	17	20.00

This data is taken from the very complete final report (1921) of the conference of Metropolitan Borough Councils, of which Mr. J. T. Watson was Chairman. Other methods of disposal include local dump, sorting for sale, etc. From these figures it appears that practically 80 per cent of London's house refuse is at present disposed of by dumping. A few quotations from the conclusion of the conference are of interest to municipal officials in this country as follows:

"(a) *Dumping on the Land.*—The system of dumping crude refuse on low-lying land in disused clay-pits and in quarries, although at present the principal means of refuse disposal, will, we believe, be generally condemned for public health reasons if for on other.

"From the point of view of public health no word can be said in favor of dumping crude refuse. Nearly all rural authorities strongly object to land in their areas being used for this purpose (although they may adopt the same means of disposal), chiefly owing to the fact that at most dumps there is no organized method of covering over

the top surface with suitable material, and no attempts are made to bring the land back into cultivation. Consequently there is a continual risk of nuisance being created by fermentation and the dump becomes a breeding ground for flies and rats.

"(b) *Dumping in the Sea.*—This proposition has been put to us, and while, if it could be assured that there would be no return of the material with the tides, the system would have the merit of being sanitary, the cost of the necessary transport to riverside wharves and sea hoppers removes it, we think, from the sphere of practicability. There is also the possibility of long delays owing to unfavorable weather conditions.

"(c) *Burning in Destructors.*—Refuse destructors have been in existence many years, and they have the undoubted advantage of disposing of the dangerous elements which develop in refuse when left to ferment and decompose.

"As regards the utilization of the waste heat, this is of value for the driving of machinery for small subsidiary undertakings, such as a mortar mill, slab making or a small electric light plant, but it appears that the variability in degree of heat produced by a destructor and the comparatively small portion of the 24 hours that it works, renders the application of the heat generated much less desirable for purposes of a power station than heat raised by ordinary fuel.

"It is our opinion that the part to be placed by the destructor in the future will be, not the burning of all refuse, but that part of which no further use can be made.

"(d) *Pulverizing or Crushing.*—The Borough of Bermondsey installed four refuse crushers in the year 1919 on the river front. The plant deals with 320 tons per week, or 16,640 tons per year. The present cost of crushing at Bermondsey is 6s. per ton owing to the high rates of wages now paid. The staff consists of 12 men and 1 foreman. Their wages represent 51.88 per cent of the total cost of crushing. The Borough Engineer informs us that there has not been an extensive sale of the material and the Council have paid a small charge to the contractor for removing it.

"(e) *Salvage of Usable Constituents of Refuse.*—The suggestion was made at one of the meetings of the conference that Mr. J. C. Dawes, Inspector of Public Cleansing of the Ministry of Health, should be invited to give us his assistance in our task. This was done. Mr. Dawes has attended most of our meetings, and we are indebted to him for much valuable information concerning the activities of provincial local authorities in the matter of refuse disposal, and with regard to the great possibilities connected with the salvage of refuse and the installations that have been set up in various parts of the country for the treatment of refuse for subsequent use. But, although unsorted refuse is objectionable and would soon become dangerous to health, the fact remains that practically every one of its component parts separated from the remainder is a usable and useful commodity.

"Salvage plants are still in their infancy, and we do not give any details as to capital costs owing to the variations possible, according to the extent to which it is desired to sort the refuse and the manner in which the residue after sorting is disposed of.

"The cost of erecting on a provided site a plant capable of dealing with from 20,000 to 40,000 tons of refuse per annum may be estimated at about £15,000. Allowing for repayment of capital and interest and for running expense and taking only a moderate estimated return on sales, a very considerable saving can be shown over present-day costs of barging or railing to dump.

"It is not suggested that destructors and other systems of refuse disposal showing some return on working should be scrapped, but it is suggested that in some cases (and they are the majority in London) where refuse is barged or railed to dump in its crude state, the Councils concerned would be well advised to give the closest and most serious consideration to the possibilities of salvage."

Mr. C. Newton Russell, chief electrical engineer to the London Borough of Shoreditch, has likewise submitted thorough going reports on this subject. He states that—

"The main defects in the present system are expense, inconvenience and annoyance, necessitated in destroying refuse in the center of densely populated areas, owing to:

"(1) Flue dust troubles.

"(2) Congestion of traffic.

"(3) Increased cost of disposal of residue, which has risen from 2 per cent per ton in 1897 to 5 per cent per ton in 1917, and is still increasing.

"(4) Want of space to deal efficiently with by-products, such as:

"Flue dust.

"Old tins and metal.

"Bones, paper, straw, etc.

"And the utilization of burn residue for the manufacture of paving slabs, mortar, bricks and road material."

He then outlines a constructive program in a suggestive way as follows:

"In order to destroy and to deal efficiently with domestic and trade refuse, special types of furnaces are required, which it is impossible to have in small local plants. The remedy for this is, in the author's opinion, centralization, and in order that these notes may not only be of a negative character, and only critical, but rather of a constructive nature, with a view to increased economy and efficiency, as well as provision for the future, the following suggestions are put forward:

"1. Collection of refuse; depots for tram and water.

"2. Centralized destructor plant.

"3. Conveyance of refuse and return of by-products.

"4. Selection of site or sites.

"5. Layout of plant, sidings, workshops, offices, workmen's dwellings, etc.

"6. By-product department.
Research department (chemists).
Generation of steam.
Disposal of residue.
Manufacture of concrete or lime clinker blocks.
Clinker for road-making.

"7. Financial aspects."

After suggesting a further development of sorting he offers a tentative scheme that—

"London should be divided into, say, four districts, with a central destructor plant on the outskirts of each area, and preefrably with river frontage. As an illustration, take the eastern area from Shoreditch eastward. A site could be obtained on the river front at Barking, or lower down. It should be connected to the local tram and rail system so that the refuse trucks could be run right into the works. The area of the site should be ample enough to provide for—

"Plant to deal with 2,000 tons per day.
"Electric generating plant.
"Repair workshops.
"By-product works for making:
Crushed and ground clinker.
Mortar.
Concrete slabs, etc.
Workmen's dwellings.

Some American Conditions.

It should not be considered that English and American problems are similar. There are differences in the per capita production of refuse, in personal habits, in population densities and the like. Moreover, refuse disposal in America is in process of development. Minneapolis, under the guidance of Mr. Engberg, City Engineer, and Mr. Jensen of the Water Department has recently built loading stations to shorten haul; has motorized its garbage collection, and is considering an increase of incinerator capacity.

Mr. John Kloren, City Engineer of New Orleans, has developed disposal by incineration only after a most careful study of haul economics. Chicago, with the lake front still available for dumping, is feeling the pinch of filled-up dumps and longer hauls. Indianapolis has developed a tractor-trailer system for ash collection to decrease the increasing costs of collection and haul. The conditions now in London and in some American cities may come to other cities before many years. There is a limit in most cases in built-up communities to the nearby dump. Special methods of disposal and a comprehensive general plan for collection and haul are the necessary steps if service to householders is not to be curtailed. The wise communities are planning now the conservation of dumps.

What About Failures?

As commonly considered the term "failure," as applied to refuse disposal projects, refers to the abandonment of a finished disposal plant representing invested capital and ready for operation. If a considerable sum of public money is put into work, and these works are not used, but are allowed to disintegrate, something is certainly wrong. Many will say that such occurrences are rare, if not unknown. Let me name a few cities where some such upsets have occurred for part or all of the refuse: New York, Buffalo, Minneapolis, Chicago, San Francisco, Los Angeles, Seattle, Gary, Fargo, Madison and others. Such upsets, however, are not the real failures. They are the symptoms of a deeper trouble. I offer for consideration some of the causes of these upsets and plant abandonments as follows:

(a) A failure, in the first place, on the part of city officials, to appreciate the true measure of a refuse disposal project. Communities should understand that the first objective is a city of clean houses, with the construction of a disposal plant secured.

(b) A failure to secure and adopt a general plan for all the refuse disposal work, including proper ordiuances and kitchen cards, collection equipment and management, transfer stations, hauling

equipment, dumping facilities, disposal work and the like.

(c) Failure to profit by co-operation with experts of independent judgment who can bring to the local problem the helpful experiences of other situations acquired through years of study and participation.

Summary.

A review of refuse disposal practice, including some of the mistakes which have been made, clearly indicates the need for a broader development in the solution of the problem. The final objective of a clean city should stand out and be accomplished through a sound, general plan, based on experience with tried methods, economically operated. The complexity of the problem is obvious.

There are four principal elements to deal with and three to be satisfied, including householders, the public and the operation and its economy. Between these four factors, namely, house treatment, collection, haul and final disposal and the three elements to be satisfied, there appear to be nineteen different relationships. Thus collection is not only influenced by the house treatment and haul, but also by items of cost in operation, public considerations, methods of final disposal and the like.

Out of these various relationships there is some combination of house treatment, collection, collection equipment, transfer stations, haul, disposal plants, dumps, sites and locations, business management and accounting, which will produce the most favorable solution. Like all major engineering problems, but in a marked degree, the refuse disposal problem is one which canont be reduced to mathematical calculation, but must be solved on a basis of experience by those who have had opportunity to study and co-relate this experience in a broad manner.

Table I—Rate of Collection Service

Data from office notes and field investigations, Pearse, Greeley & Hansen, September, 1922.

City.	Material.	Number of Houses Per Wagon Per Day.
Pittsburg	Rubbish	145
Rochester	Rubbish	167
Charleston	Garbage	250
Fargo	Garbage	210
Toledo	Garbage	275
Montclair	Garbage	300
	Ashes	200

The foregoing paper, by Mr. Greely, was presented at the recent annual meeting of the American Society for Municipal Improvements.

HIGHWAY BRIDGE RECONSTRUCTION POLICY IN PENNSYLVANIA

It will not be many years before the old narrow stone bridges crossing streams and ravines on State Highway Routes in Pennsylvania will have passed into oblivion and new structures, or rebuilt old ones widened to meet traffic conditions of today, will grace the highways in their stead.

Motor traffic has increased so amazingly within the past few years that the Pennsylvania State Highway Department has sensed the absolute necessity and importance of wider bridge structures on its road system, which will make it possible for automobiles, trucks and other vehicles to pass each other without danger of collision.

A recent survey made by the Department shows a total of 1,834 bridges less than 16 ft. wide—many of which cannot carry two vehicles at the same time—that are located on roads which have been made a part of the State Highway System. Under the law trucks are permitted a width of 90 ins. and, consequently, these old narrow structures constitute an ever present and serious menace to all users of the highways.

Plans now are being prepared to widen the more vitally important ones located on heavily traveled highways, so that when the working season opens up in the spring—and if the present financial resource for repairs is continued—operations may commence immediately. However, some of these structures were built 50 or 100 years ago and are in such condition that to repair them would not be economical, or advisable, and new construction is therefore necessary, while in some instances the cost of widening is prohibitive at the present time, so that contemplated changes will have to be held in abeyance until further appropriations are available for this purpose.

In the meantime the Department is exercising every precaution for the safety of the traveler and warning signs are being erected which read: "Danger! One-way Traffic Bridge."

The policy of the Department is to construct all new bridges with a width of at least 24 ft. and in the improvement of those which are not entirely rebuilt, according to a statement by Assistant State Highway Commissioner George H. Biles, "Every effort will be made by the Department to retain the contour and general architectural characteristics of the old

structures which are landmarks in the communities where they are located and in many instances replete with memories of personages and events connected with the early history of Pennsylvania."

NO DETOURS—ROAD UNDER CONSTRUCTION—DO NOT STOP

By George C. Warren, Chairman, Executive Committee, Warren Brothers Company, 9 Cambridge St., Boston, Mass.

What a blessing it would be if road construction generally were accompanied by a sign reading, "No Detours—Road Under Construction; Do Not Stop," instead of the customery barricade and "Detour" sign with hand pointing up a rough, dusty or muddy, unimproved road. How many miles the detour hand signifies the traveler knows not.

An article in the September issue of Municipal and County Engineering, "Detour Practice of Pennsylvania State Highway Department," gives some valuable thought by way of standardizing the signs and making them mechanically more desirable or permanent and indicating thereon some idea of the length of the detour, such as "To Lancaster via Columbia," but not a word regarding overcoming the annoyance and expense of such detours.

This expense is generally given scant consideration in the design and in contracting for highway construction. It not only involves generally immeasurably great expense to the tax-paying public in maintenance of detours, but probably even greater expense in additional maintenance of automobiles, to say nothing of the annoyance to motorists of plowing through dusty or muddy or over rough and rutted roads, often for several miles.

During the past year, in a Masschusetts town, in connection with awarding a contract for about one mile of road, one bidder, who was about $1,000 high, agreed to construct the work without detours, and at all times to permit normal traffic through the road under reconstruction and to complete the work in three weeks. The contract was awarded for the cheaper (?)

VIEW ON LOWER COLUMBIA RIVER HIGHWAY IN OREGON, BUILT IN 1915 WITHOUT CONSTRUCTION DETOURS.

A FEDERAL AID ROAD IN ARKANSAS COUNTY, ARK., BUILT IN 1920. NOTE FLOODED RICE FIELDS AT SIDE OF ROAD MAKING DETOURS IMPOSSIBLE.

type of road and the town thought it was saving $1,000. The thoroughfare was barricaded from traffic for over four months and the public obliged to detour more than two miles off the main highway. One of the town officials subsequently told the writer that the maintenance of the detour roads to keep them in passable condition cost the town over $2,000. Which was the cheaper bid?

Detours on country highways can be and very frequently have been entirely avoided, and that without in any way injuring the roads under construction and without discommoding either the contractor or traveling public. Four remarkable instances are shown in the accompanying photographs due to the contour of surroundings through mountainous and flooded country, to-wit: 70 miles of the Colum-

CAMP PIKE FEDERAL AID ROAD IN ARKANSAS. BUILT IN 1917, 10 MILES, NO CONSTRUCTION DETOURS.

bia River Highway (Oregon), constructed in 1915; 7.3 miles of the Ogden-Canyon road (Utah), constructed in 1920; Camp Pike Road (Arkansas), 10 miles, constructed in 1917, which, while under construction, carried the immense war period military traffic from Little Rock to Camp Pike, and a road through the flooded rice fields of Arkansas County, Arkansas, laid in 1920. Many similar instances could be given.

This cannot be accomplished by the laying of either base or surface of rigid material, which requires weeks or months to set before traffic can be allowed to pass over it. In the instances above referred to the foundations were of non-rigid types, which are not injured by passing traffic, namely:

Columbia River Highway, new compressed stone base; Camp Pike Road, old macadam utilized as the base for new surface; Ogden-Canyon Road, old macadam raised to desired contour and elevation by asphaltic concrete base. Particularly note that the illustration of this road shows a steam roller at work, as well as automobile, passing over the work while under construction. Arkansas County, Arkansas, new compressed stone base.

The wearing surface in all cases was of the Warren type, no part of which is damaged by passing vehicles either before or during the process of compression, and which is thrown open to traffic without even a watchman within five hours after the compression is completed, that is, as soon as the temperature of the road surface is reduced to that of the air.

ODGEN-CANYON FEDERAL AID ROAD, UTAH. BUILT IN 1920, 7.3 MILES. NO CONSTRUCTION DETOURS.

Construction News and Equipment

IOWA ROAD BUILDER MOUNTS CONCRETING EQUIPMENT ON RAILWAY CARS

Mounted on wheels from mixer to cook shack, one Iowa concrete road builder's outfit is ready at a word to pull up stakes from the job at hand and move at railroad speed to a new location, says a recent issue of the Service Bulletin of the Iowa State Highway Department.

Fully motorized and fully equipped with wheels, railroad wheels at that, most of the time, the whole camp can be en route in case of necessity or expediency in a few moments' time. On arrival at the new site with equal celerity it can be fully established and going at full efficiency. Incidentally, too, this is one of the most completely equipped paving outfits in Iowa. It has been consistently making a fine daily average of pavement actually laid.

When C. F. Lytle of Sioux City found that as a result of Woodbury County lettings he had in hand a 14-mile contract for concrete pavement, with two or three settings of an outfit necessary and with other jobs in prospect of rather short mileage, he determined to organize an outfit and design a plant and equipment so that as little time as possible would be actually lost in the necessary moving. A central proportioning and mixing plant was selected as best adapted for the work on hand and in prospect. A railroad flat car of ordinary type was one of the first purchases. One end of this was mounted a Lakewood mixer of 56 cu. ft. capacity per batch. On the other end the Wisconsin Model M gas engine was mounted, with a belted drive connecting to the mixer. The engine was housed in with a wooden cabin for protection from the elements. Fabricated steel was used to build a frame work about the mixer to support the necessary hoppers above for sand and gravel, and with heavy bolted removable supports to rest upon the ground and give stability to the outfit. Two long canvas belt carriers extending directly along the car side at the back of the mixer provide two separate elevators for the cement, which is dumped from the sacks into the carrier hoppers from the cement supply cars at either end of the mixer car. The cement carriers are necessary to keep an unbroken supply of material. When working at full capacity one carrier with one crew emptying cement sacks into the hopper at the bottom cannot supply the mixer. Fourteen full sacks of cement are required for each catch. The two carriers also make unnecessary a complete shut down of the mixer equipment while one cement car, after being emptied, is run out and the new one brought in.

A locomotive crane is one of the handiest and busiest pieces of equipment about the plant. The crane unloads the sand and gravel from the supply cars into the reserve stock pile. It keeps the hoppers at the top of the proportioning bins filled and ready for dumping as each new charge is required. When cars need to be shunted about, it does the shunting. If the cook shack and dining cars are to be moved or a load of lubricating oil or gasoline brought in from the side track, where the freight train crew left it, is not necessary for this Lytle plant to wait until the local freight comes through next day to have the job done. The crane simply swings its long boom into line and is ready for business as a freight engine. It does all of the odd jobs about the camp which are too big or too heavy for the trucks to do, and it is busy practically every minute of the day.

But the real show part of the Lytle camp equipment is the line-up of Kissel trucks when they report in from the final trip of the day or for the noon meal. These special Kissel road builders' trucks are equipped with automatic hoists and pneumatic tires. These trucks, moreover, are no juvenile affairs. They are high powdered, of mammoth size and carry huge loads. For instance, the single batch of wet concrete they carry weighs over four tons and the front tires are 36x6 ins. and the rear tires are 44x10 ins. A Ford casing, it seems, could be thrown through the opening in one of these casings without touching the larger one. Placed side by side the Ford tire looks like a toy. The entire equipment alone, on this set of trucks, represented when new an outlay of $20,000.

A fully equipped repair shop with competent foreman and several mechanics is maintained to keep the trucks and the balance of the equipment in the best condition at all times. When a truck has tire or any other trouble when out on the road the first truck passing him carries the word to the repair shop and a service truck, fully prepared, if possible, to meet the needs of the emergency at hand, makes the run with very little loss of time. If the repair can be made on the spot by the roadside in short order it is unnecessary usually to switch the load of wet batch concrete to another truck. If the repair requires too much time, the batch is usually transferred and carried on to its destination. Very few loads of material have been lost because of the delay of a truck while en route with its load. The trucks, even when loaded, travel at a high rate of speed and the wet concrete batch has been successfully transported a distance of eight miles without detriment. The entire round trip at the time the eight-mile run was being made took approximately one hour. So carefully have the mechanical needs of the trucks and other equipment been looked after by the repair shop and its force of men that in four months' time practically no delay has been experienced on account of having to make repairs on equipment during working hours.

A Lakewood sub-grader is used to shape up the grade and a finishing machine of the same make shapes, tamps and gives the finishing touch to the concrete slab. This machine is followed by hand finishers who complete the work of surface finishing, build the sloping intergral curb on steeper grades and the special design drainage intakes. These latter are built into the edge of the slab at the curb line.

Caring for its equipment does not absorb all the attention of the company. To keep the men satisfied and contented on the job has been one of the features which has led to the good construction record made by the company.

To house the kitchen and dining room two box cars of the Palace horse car type were purchased. One was entirely rebuilt inside and equipped, at one end, with a complete camp kitchen outfit. This contains all supply bins, shelves and refrigerator. The balance of the car not needed for the kitchen was rebuilt as a small dining room. The second car was entirely equipped as one large dining room. It is possible to seat comfortably, in the two rooms, a total of 75 men at one time. Sleeping quarters for the men are provided in tents or frame buildings if the latter are available or the time on the job seems to warrant. A special cook shack and sleeping quarters are provided for all colored help on the job.

The Lytle construction for 1922 for Woodbury County covers approximately 14 miles of concrete pavement in three separate projects. Primary road project No. 187 covers a little over one mile on road No. 23 in the town of Moville. Federal aid project No. 2 extends out from Sioux City limits about 5½ miles south on the road No. 34, the Sioux City-Denison road, sometimes called the Smithland Road. Federal aid project No. 136 extends south from Sergeants Bluffs to Salix on road No. 12 approximately 7 miles. This latter is called the Sergeants Bluffs road.

Thirteen days' work on the Sergeants Bluffs road netted in actual accomplishment an average of 718 ft. of complete pavement laid, an average of 1,436 sq. yds. of concrete slab 8 ins. thick and 18 ft. wide, or 320 cu. yds. of material actually placed on the road.

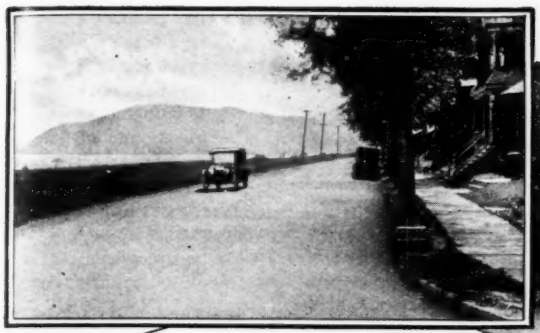
Fifteen days' work on the Smithland Road netted an average of 620 ft. of pavement slab laid per day, 20 ft. wide and 8 ins. thick, an average of 1,376 sq. yds. of road surface covered, or 340 cu. yds. of material placed.

Twenty-five days' work, also on the Smithland Road, but of 18 ft. width pavement, averaged 850 lin. ft. per day of roadway, 1,700 sq. yds. of pavement slab, or 275.5 cu. yds. of material placed.

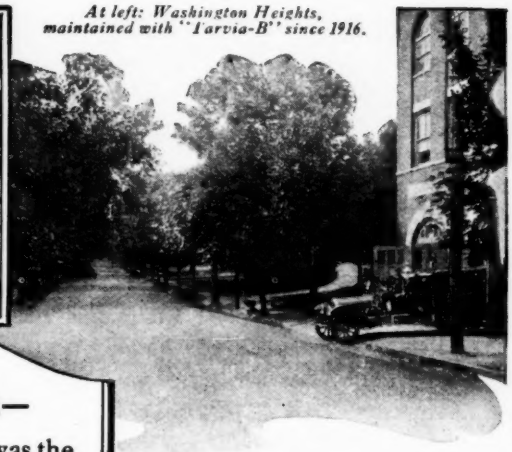
These figures are from daily reports of work accomplished.

Photographs of the camp and equipment show that considerable thought and time must have been given, not only to the design of the individual parts of the outfit, but to the general arrangement of the various units comprising the plant in order to facilitate the handling of materials. The one feature that marks this plant as distinct from other 1922 road building plants is the fact that every important individual unit of the equipment from mixer to cook shack can be almost instantly ready for transport from one point to another by reason of its more or less permanent mounting on railroad cars.

Mr. Lytle in 1921 built 17 miles of concrete pavement for Woodbury County on the Sioux City-Correctionville road. With the completion of his present contract he will have built 31 miles of pavement for his home county.



At left: Washington Heights, maintained with "Tarvia-B" since 1916.



"Tarvia-B" makes good in Newburgh—

Benkard Avenue, pictured in the circle, was the first Tarvia street in the City of Newburgh, New York. The results were so satisfactory that in 1916 other macadam streets were given their initial Tarvia treatments. Not until last year, however, when the 18 miles of roadway shown on the accompanying street map were surface-treated with "Tarvia-B", was the use of all other kinds of road-maintenance material entirely abandoned in favor of Tarvia.

Mr. W. J. McKay, City Manager, wrote under date of March 17, 1922:

> "It is with a great deal of pleasure that I inform you that the results obtained from the use of your 'Tarvia-B' on the streets of this city last season were more than satisfactory.
>
> "While we are always in the market for material cheaper than the material we used the preceding season, it would take a considerable difference in price to have us make any change in the product to be used for the season of 1922."

Economy must be the goal of every conscientious public official. And the officials of Newburgh, and hundreds of other cities and towns throughout the country, have found from experience that Tarvia is the most economical of all road materials.

Above: Du Bois St., maintained with "Tarvia-B" since 1916.

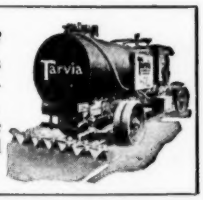
Below: Benkard Ave., maintained with "Tarvia-B" since 1913.

Tarvia

For Road Construction Repair and Maintenance

A Grade for Every Purpose

Tarvia is made in various grades for all road purposes—new construction, repairs and maintenance. An illustrated booklet telling of the different Tarvia Treatments will gladly be sent free on request.



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The Barrett Company

CONSTRUCTION PRICES NOT LIKELY TO DECREASE IN NEAR FUTURE

That construction costs will continue to increase to a higher level than at present, and that the demand for construction will continue for some years to come, is the opinion of the Associated General Contractors of America, in a statement made recently to James A. Wetmore, Acting Supervising Architect, who is quoted as authority for the statement that within the next 18 months the country may look for a very material drop in the cost of building.

In the *United States Advertiser* it is reported that $15,000,000 worth of Federal buildings throughout the country are being held up for a drop in the cost of construction expected within the next 18 months.

Not only has the cost of building been going up for several months, according to the Associated General Contractors, but so has the cost of materials. Wages in the building trades have more recently begun to increase also. The general average of wholesale prices has been increasing since the first of the year.

"The behavior of all these prices in increasing during a time of recovery from business depression," state the contractors, "is entirely normal. It is a phenomenon which always occurs during like periods. We believe it is a very strong indication that prices in general have been stabilized for the present on a new price level in the neighborhood of 70 per cent higher than that which prevailed in 1913. This means that prices will continue to go up until the present period of prosperity is fully established and will not go down again until the beginning of the next business depression. The next depression will probably be only a moderate one, such as we were familiar with before the war, and will be accompanied by only moderate decreases in prices.

"Instead of expecting that building costs will be materially lower 18 months from now, we anticipate that they will continue to increase during the greater part of that period, and that they will be at that time, perhaps, at about the beginning of a decrease, but at a point higher than the present. We believe further that the decrease which may be expected to begin at about that time will not go to a point very much below the figures reached during the past winter."

In explaining their reasons for their opinions, the contractors say that the costs of building materials are going up partly because they are partaking of the general tendency of prices to rise during this part of the economic cycle, and partly because we are experiencing a building boom of unprecedented volume. Wages of building labor are increasing partly because of the shortage brought about by this same building boom and partly because of a recovery in other lines of industrial activity, which is already beginning to produce labor shortages.

"One important aspect of this phenomenon," they state, "is the shortage of common labor, which is due, in large measure, to the almost complete extinction of immigration for the past nine years, caused first by the Great War and latterly by our preesnt restrictive immigration act. That this shortage of common labor in fields other than the building trades is a very real one is proved by the recent action of the United States Steel Corporation, and a number of the other important steel companies, in making large voluntary increases in their wage scales.

"It may be that some believe the present building boom has about run its course, and that for that reason building activity will soon diminish and building costs go down. We believe the outlook to be far otherwise. The boom shows no signs of abating. For six successive months the figures for contracts let have been record-breaking. The slight recession of August is less than the usual seasonal recession. As a result of very painstaking investigations it has been estimated that the deficit in building, the country over, is so great that building could continue for ten successive years, beginning with this year, at 25 per cent above normal before catching up with that deficit. We do not predict any such sustained activity, but we do point to the figures as proof that there is no possibility of the present building boom coming to an end within the next few months, because of having completely filled the demand for new construction."

THE AUSTIN NO. 12 DRAGLINE

The Austin No. 12 Dragline, shown in the accompanying illustration, embodies in its design and construction many features which are sure to meet the approval of engineers and contractors.

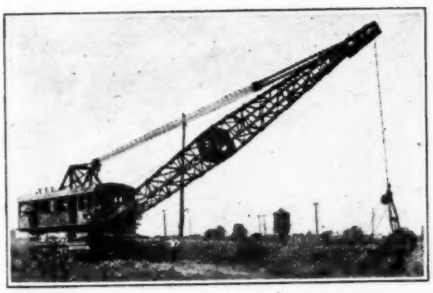
In general the excavator is of the full revolving type and is mounted on two multipedals. A 6-cyl. heavy duty type gasoline motor provides 250 h. p. at 425

R. P. M., which power is more than ample to drive the machinery under all circumstances. Semi-diesel engines can be substituted if necessary.

An air compressor and storage tank, the former operated through a direct connection to the main motor, provides air for the air rams which control the drag and hoist drums, the swinging mechanism of the machine and an air starter for the main motor.

Since machines of this type are worked continuously day and night, powerful electric lights are installed, so that the work of excavating can proceed without interruption.

Extra large multipedals provide in a machine of this class a hitherto unequalled bearing pressure of 1,150 lbs. per sq. ft., which is sufficient to enable the machine to travel on its own power over extremely



THE AUSTIN NO. 12 DRAGLINE.

soft surfaces without the use of mattresses or artificial supports of any kind. Standard equipment is 2½ cu. yd. Page bucket and 60 ft. boom. Longer booms and smaller buckets or shorter booms and larger buckets can be furnished.

This type of machine, on account of its adaptability for swamp work, is now giving an excellent performance on reclamation work in Florida. The machine is extremely mobile, having a low speed forward of ½ mile per hour, and a high speed forward of ¾ mile per hour. The wide-faced multipedals enable it to travel over the Everglades quickly and without miring. The machine is very fast in operation and records of 2,400 yds. in ten hours have been made with it. As an example of the painstaking care exercised by the manufacturers in their efforts to produce a machine finished in every detail, it might be of interest to add that an electric fan has been provided on machines going into hot southern climes, which serves both to cool the operator and blow mosquitoes away. These machines are manufactured by the Austin Machinery Corporation, Dorr St., Toledo, O.

THE 1923 GOOD ROADS SHOW

With the early start that was made during the summer through a partial reorganization and an election of officers in the American Road Builders' Association and the creation of the Highway Industries Exhibitors' Association to bring about closer co-operation, arrangements are rapidly being perfected for the Thirteenth American Good Roads Congress and Fourteenth National Good Roads Show to be held in Chicago, January 15, 16, 17, 18 and 19, 1923.

The early beginning has enabled those in charge to perfect a working organization so harmonious and effective that conditions nearly 100 per cent perfect are assured for the next big double event. While many of the most important features of both congress and show will be retained, others both new and novel will be added.

It is the intention to separate the congress and show by holding the former at the Congress Hotel and the latter, as usual, at the Coliseum. It is believed this arangement will be more satisfactory, as it will obviate the necessity of shutting down the operating machinery during the sessions, and will eliminate the noise that has proved so annoying to speakers and delegates at the convention. The new arrangement is also expected to increase the attendance at each session of the congress.

Shortly after his election, Thomas J. Wasser, president of the American Road Builders' Association for 1922-1923, appointed to the Executive Committee the following: Charles M. Upham, state highway engineer for North Carolina; James H. MacDonald, consulting highway engineer, New Haven, Conn., and J. H. Cranford of the Cranford Paving Company, Washington, D. C. By reason of his position as secretary, E. L. Powers became ex-officio a member of the committee.

This committee, acting for the A. R. B. A,. appointed Messrs. Upham and MacDonald, and the Highway Industries Exhibitors' Association designated its president, S. F. Beatty, vice-president of the Austin-Western Road Machinery Company of Chicago, to act as a committee having general charge of the arrangements for

both the show and the congress. The committee is known as the Convention and Show Committee.

This committee has now created several sub-committees to have charge of the various detailed arrangements as follows: Transportation Committee, Royal M. Allen, chairman; General Publicity Committee, S. T. Henry, chairman; Chicago Press Committee, W. R. Harris, chairman; Exhibitors' Committee, C. R. Ege, chairman; Entertainment Committee, A. C. Cronkrite, chairman; Reception and Hotel Committee, John B. Hittell, chairman; Registration Committee, L. S. Louer, chairman; Banquet Committee, Joseph R. Draney, chairman; Program Committee, E. J. Mehren, chairman.

The Exhibitors' Committee has employed a professional director of exhibits in C. W. Kelley of Chicago, who, though never before identified with the road show, has managed some of the biggest expositions in the country, and the Publicity Committee has re-engaged C. S. Lee of New York, who handled the publicity work for the shows and conventions in 1921 and 1922.

According to Chairman Upham, of the Convention and Show Committee, the chief difficulty will be encountered in providing space for all the exhibits, though arrangements will be made for all the additional space it is possible to obtain. "The Highway Industries Exhibitors' Association," said Mr. Upham, "is giving us splendid co-operation in working out the arrangements. We expect to conduct a publicity campaign of greater compelling force and more far-reaching effect than ever before, and I believe the attendance will break all records.

"The program for the Congress as it is being worked out by the Program Committee will be the exact reversal of our previous ones. Instead of avoiding controversial subjects, as in the past, the program next year will be made up almost entirely of controversial subjects of interest to the road-building industry as a whole. This, we believe, will greatly increase the interest in the program, and will provoke highly interesting and instructive oral discussions from the floor."

The American Road Builders' Association has opened new offices at 37 West Thirty-ninth St., New York City, the old ones at 11 Waverly Place having been abolished. Headquarters will also be opened in Chicago long in advance of the congress and show.

PERSONAL ITEMS

Edward E. Duff, Jr., newly elected Secretary of the National Paving Brick Manufacturers' Association, will assume office on or about January 1. Maurice B. Greenough, retiring Secretary, will become associated at that time with Mr. W. M. Lasley, of Chattanooga, Tenn., in various enterprises, including the manufacture of paving brick. Mr. Duff comes to the National Association particularly well fitted to assume charge of its increasing activities. Following several years of experience in railroad engineering with the Pensylvania

EDWARD E. DUFF, JR.

Railroad, he spent several years in municipal engineering and management at Sewickley, Penn. When the United States entered the war he was commissioned and served for two years with the A. E. F. in France as Captain of Engineers. This, with his subsequent experience as field engineer for three years with the Eastern Paving Brick Manufacturers' Association, places him in a position where he can be of service in the street paving and highway construction field, as well as in the paving brick industry. Mr. Duff is a graduate of the Department of Civil Engineering of Carnegie Institute of Technology, where he was awarded the degree of B. S.

in C. E. in 1913, and in 1917 the degree of C. E. He is an associate member of the American Society of Civil Engineers and a member of the American Society for Municipal Improvements, the Society of American Military Engineers and the Engineers' Society of Western Pennsylvania.

C. A. Jennings, District Sales Manager for Wallace & Tiernan Co., Inc., at Chicago, resigned, effective Nov. 1. He has taken offices in the Monadnock bldg., Chicago, and will act as manufacturer's sales representative for the Michigan Valve and Foundry Co. of Detroit; Roberts Filter Mfg. Co., of Darby, Pa.; Universal Destructor Co., of Pittsburgh, and other firms manufacturing water works and sanitary engineering equipment.

At the annual meeting of the Milwaukee section of the American Society of Mechanical Engineers, Will J. Sando was elected chairman for the ensuing year. Mr. Sando was a member of the Board of Managers of the American Society of Mechanical Engineers from 1908 to 1911. Mr. Sando is an internationally known engineering expert. In the year 1900, when he left Boston, he was superintendent of pumping stations of the Metropolitan Water Board of the Commonwealth of Massachusetts, and later chief engineer of the Water Works and Condenser Department of the International Steam Pump Company, New York; engineer of the Department of Pumping of the Commission on Additional Water Supply for the City of New York, and manager of the Pumping Engine and Hydraulic Turbine Department of the Allis-Chalmers Manufacturing Company, Milwaukee. Since 1910 Mr. Sando has been in private practice as a consulting engineer at Milwaukee.

Weston E. Fuller has withdrawn from the firm of Hazen, Whipple & Fuller, Civil Engineers, 30 East 42nd St., New York, to become professor of civil engineering in Swarthmore College. The firm name is changed accordingly, and again becomes Hazen & Whipple, which was the name from 1904 to 1914, inclusive. All the other partners remain in the firm. Prof. Fuller will continue the active practice of civil engineering, and Mr. E. W. Doebler, formerly with Hazen, Whipple & Fuller, will be associated with him in this work.

Abel Wolman was elected Chief Engineer to the Maryland State Department of Health on Sept. 21 by the State Board of Health, to succeed Robert B. Morse, resigned. Mr. Wolman will continue his activities as lecturer in sanitary engineering in the Johns Hopkins University School of Hygiene and Public Health and as editor of the Journal of the American Water Works Association.

MICHIGAN GRADUATE SHORT COURSES IN HIGHWAY ENGINEERING AND TRANSPORT

(Editor's Note—Following is the schedule of the 1922-23 Graduate Short Period Courses in Highway Engineering and Highway Transport which will be offered by the University of Michigan during the Winter period, Dec., 1922, to March, 1923. This is the only institution offering such courses for credit towards advanced degrees. The attendance on these courses has steadily increased during the past three years, as indicated by the following data: 1919-1920, 29 men; 1920-1921, 45 men, and 1921-1922, 94 men. The average age of the men in attendance last winter was 27 years, varying from 22 to 54 years. They came from national, state, county and municipal highway departments, consulting engineers' offices, contractors' organizations, university faculties, companies manufacturing highway materials and machinery and the field of highway transport. Last June the University conferred 16 Master's degrees on graduate students specializing in highway engineering or highway transport. The Board of Regents, in recognition of this rapid development, has assigned to the division of Highway Engineering and Highway Transport 26,000 sq. ft. of working space for the Davis Library of Highway Engineering and Highway Transport, offices, graduate lecture rooms, drafting rooms and laboratories in the new $750,000 engineering building:)

Dec. 4 to 15, 1922.

C. E. 77.—Highway Engineering, Financing, Management and Organization.—Professor Smith.

C. E. 81.—American and English Highway Transport Methods.—Professor Blanchard.

Dec. 18 to 30, 1922.

C. E. 67.—Highway Transport Economics and Surveys.—Professors Blanchard and Smith.

C. E. 72.—Gravel and Broken Stone Roads, Dust Prevention and Bituminous Surfaces.—Professors Blanchard and Smith.

Jan. 1 to 12, 1923.

C. E. 73.—Brick, Cement-Concrete, Stone Block and Wood Block Pavements.—Professor Bateman.

C. E. 80.—Interrelationship of Highway, Railway and Waterway Transport.—Professor Riggs.

Jan. 15 to 26, 1923.

C. E. 69.—Highway Laboratory Research.—Professor Bateman.

C. E. 70.—Highway Structures.—Professor Gram.

C. E. 82.—Highway Transport Costs and Record Systems.—Professor Smith.

Jan. 29 to Feb. 9, 1923.

C. E. 68.—Bituminous Macadam, Bituminous Concrete and Sheet Asphalt Pavements.—Professor Blanchard.

C. E. 84.—Highway Transport Management.—Professor Smith.

M. E. 40.—Mechanism, Operation and Maintenance of Motor Trucks, Tractors and Trailers.—Professor Lay.

Feb. 12 to 16, 1923.

Ninth Annual Michigan Conference on Highway Engineering.

Feb. 19 to March 2, 1923.

C. E. 71.—Highway Specifications, Contracts and Jurisprudence.—Professor Riggs.

C. E. 79.—Highway Transport Legislation and Traffic Regulations.—Professor Blanchard.

March 5 to 16, 1923.

C. E. 75.—Highway Engineering Seminar.—Professors Blanchard and Bateman.

C. E. 76.—Highway Engineering Theory and Design.—Professor Smith.

C. E. 78.—Earth and Sand-Clay Roads and Grading Machinery and Operations.—Professor Bateman.

C. E. 83.—Highway Transport Seminar.—Professors Blanchard and Smith.

A PORTABLE SAND AND GRAVEL DRYER

The Littleford Sand and Gravel Dryer No. 12, here illustrated, makes possible the heating and drying of sand and gravel without the need of mechanical equipment. No skilled labor is required to operate it and there is no cause for expensive delays which are incidental to mechanical dryers.

The operation of this dryer is quite simple. The material to be dried is filled in at the top and comes in contact with a heated arch plate over the furnace. As the material dries, it flows from the convex surface of the arch plate to ledges on both sides of the dryer. Perfectly dry and heated material is removed from these ledges as needed.

The construction is very durable. The shell and furnace are made of 3-16-in. steel. The firebox is all ¼-in. steel, with ¼-in. renewable steel liner plates. The arch plate is made extra heavy of ⅜-in. steel, with heavy stiffeners to prevent warping.

The furnace shell, which extends the full length of the dryer, has a firebox of

THE LITTLEFORD NO. 12 SAND AND GRAVEL DRYER.

ample proportion at the rear and which is fitted with heavy cast iron renewable grate bars. It is also fitted with an improved type of cast iron fire door. The ash pan under the grate is built integral with the firebox.

The dryer is mounted on all steel wheels, with wide tires and staggered spokes. Axles are tapered and machine turned. This dryer is manufactured by Littleford Bros., 460 E. Pearl St., Cincinnati, Ohio.

GARAGE OF INDIANA STATE HIGHWAY COMMISSION

The big garage of the Indiana State Highway Commission, where hundreds of motor vehicles, consisting of trucks, touring cars, roadsters, trailers and motorcycles are kept in repair, often completely rebuilt, is held as a model of efficiency by numerous state high commissions of the Middle West, who have sent their shop foremen to Indianapolis to get a close-up, so to speak, of how it operates under the guidance of George N. Bartley, superintendent of the motor transport.

The Ohio Highway Commission has sent its transportation chief (J. T. Shafer) here on two occasions, and D. H. Cornell, of Springfield, head of the Illinois State highway transportation system, writes that he is sendiing his garage superintendent here to learn the methods of rebuilding cars as carried on at the Indiana Highway Commission's garage. According

to John D. Williams, director, the transportation heads of half a dozen state highway commissions have visited the Indiana garage in the last few weeks.

When it is recalled that the bulk of equipment worked upon at the state garage consists of cars and motors formerly in war service, the major portion of them have to be rebuilt and all have to be torn down, cleaned and reassembled, it is readily seen that the task of keeping this rolling stock in condition for maintaining several thousand miles of state roads is no slight one.

Frequently garage mechanics figure out new parts which they make and eliminate the purchase of expensive stock parts. A recent illustration of this was the manufacture at the garage of an attachment for the rear part of a big truck of certain design which functions properly and does away with the universal joint. Tests prove the new device strengthens the truck. Mr. Bartley explains that the new device is manufactured in the state garage for $10, and the cost of a new universal joint is $53.

NEW CROSS SECTION FOR ILLINOIS CONCRETE PAVEMENTS

The following announcement pertaining to the new cross-section for concrete pavements on Illinois state highways was recently issued by Frank T. Sheets, Superintendent of Highways, and Clifford Older, Chief Highway Engineer of the Illinois State Division of Highways:

This cross-section provides for a thickness of 9 ins. at the edges of the pavement, tapering to 6 ins. at a distance of 2 ft. from the edges. The remainder of the pavement is to have a uniform thickness of 6 ins. The amount and arrangement of reinforcement is to be the same as that heretofore used, with the exception of the center joint material, a new design for which has been provided to correspond with the 6-in. center thickness.

This new cross-section was adopted as a result of the Bates road tests, which show conclusively that the strength of the edges of any rigid pavement, built in accordance with any design heretofore used, is much less than the strength of the interior portion of the slab.

The Bates' tests disclosed the fact that a center thickness of 6 ins., or even perhaps 5 ins., is ample to support the legal load limit provided by Illinois statutes. The new cross-section takes advantage of this fact. The tests further indicate that even with a 6-in. thickness for the main portion of the slab, a 7-in. edge with the ¾-in. longitudinal bar would still not be as strong as the mid-portion of the slab. The edge thickness has, therefore, been increased.

Particular attention is called to the fact that the new cross-section provides 1 sq. ft. less of cross-sectional area than a slab having a 7-in. uniform thickness. This means that the new cross-section will require 195½ cu. yds. less of concrete per mile of pavement than the standard 7-in. design heretofore used.

The Department believes, therefore, that the new cross-section will provide a pavement which not only is better able to support trucks loaded to the legal limit, but will also reduce the cost per mile.

At first sight it might seem that the cost of shaping the sub-grade to accommodate the new cross-section would be troublesome. A little consideration, however, will indicate that the extra cost would be very small, as sub-grading machines may easily be adapted to cut the sub-grade to the new form. Even should the sub-grade be cut to the usual crown, at an elevation of 6 ins. below the top of the forms and the dirt along the edges is then thrown out by hand, it may be seen that the additional cost of shaping the sub-grade would be but a small item.

Contractors are earnestly requested to consider this new cross-section carefully, in order that we may co-operate as heretofore in building the best and the most durable roads with the least expense to the State of Illinois.

PAVING GARY (IND.) SECTION OF DUNES HIGHWAY

Good progress is being made in paving the Dunes Highway near Gary, Ind., where for a mile and a half the road passes through a marsh. The contract for 7 miles is held by the General Construction Company of Gary. When this company started through the marsh to make a fill for the right-of-way, it was necessary to dredge out and remove many tons of muck and vast quantities of decaying vegetation, before the fill could be built from sand, on which the concrete pavement is laid. Many difficulties were experienced in making this fill, according to Mr. Moe, superintendent of the construction company, chief of which was

getting machinery and equipment across the swamp onto the right-of-way.

Parts of this preliminary work necessitated crossing the swamp with a 30-ton dredger, caterpillar type. At one place the big machine mired, and to get it again on firm ground it had to be hauled out by an interurban motor car. A long steel cable was procured at Chicago, and by means of this cable the traction motor, operating on the interurban line, which parallels the highway, and is only a short distance away, was able to extricate it. The job cost $1,000, Moe says.

The Dunes Highway is approximately 20 miles long, and is almost an air-line route between Gary and Michigan City. It is destined to be one of the most heavily traveled highways in the Indiana state road system, as it will care for traffic between Chicago, through Gary, Indiana's chief steel city, to Michigan City, a famous summer resort, and farther east it will connect with a state road through Michigan and thence through eastern states to the Atlantic seaboard.

The construction of the Gary end is considered the most unique road-building project in Hoosier highway construction, and is being watched by highway engineers in all parts of the country. Many have visited the project. Difficulty in obtaining right-of-way and also materials, the latter due to industrial tie-up, prevents the entire 20 miles of pavement being laid this year. However, most of it will be completed and the remaining gaps closed next spring.

PROGRESS ON IDEAL SECTION OF LINCOLN HIGHWAY

That progress in the construction of the Ideal section of the Lincoln Highway was considerably delayed by the railway strike, and the resulting cessation of material shipments, is announced by the Lincoln Highway Association.

This famous piece of road between Dyer and Schererville, in Lake County, Indiana, the design and construction of which has probably received more thought and care than any other section of road in the world, is being built by the Association to demonstrate what is believed to be the last word in modern, durable highway specifications for main routes of heavy travel. While the stretch is not long, being less than a mile and a half in length, it is being constructed with the utmost care and under the combined supervision of the Federal Government, the State of Indiana and the Lincoln Highway Association. Every safeguard is being thrown around the work, to the end that the completed paving may be in every respect as perfect as modern highway engineering can produce. The work is therefore not being unduly rushed.

W. G. Thompson, Consulting Engineer for the Lincoln Highway Association, and representing also its Technical Committee of highway engineers and other authorities, recently inspected the progress of the work, following the resumption of material shipments. Following a conference with C. Gray, State Highway Engineer of Indiana, and Albert Scott, Vice-President of Lockwood, Greene & Co., Engineers, in charge of the work for the Lincoln Highway Association, he announced that no chances will be taken in laying any of the concrete pavement during cold weather. This means that the pavement will probabily be completed from the west end of the section to the bridge this year and the balance of the paving, toward Schererville, be postponed until Spring. The old macadam now extending west of Schererville will not be torn up, so that traffic will meet with a minimum of inconvenience during the Winter.

Both bridges are now rapidly nearing completion, and the State has finished the 18 ft. concrete road which will connect the west end of the Ideal section with the Illinois State line. This section of paving was built to the usual State specifications, i. e., 8 ins. thick, without reinforcing.

The Ideal section paving will be 40 ft. wide on a 100 ft. right-of-way, and 10 ins. thick, 80 lbs. of reinforcing steel being imbedded in every 100 sq. ft. The State is paying, as its share of the Ideal section cost, only the amount it would pay for the usual State specifications, i. e., $33,000 per mile. The County has agreed to finance the cost of the bridge and culvert and the Lincoln Highway Association is providing the funds to meet the balance of the cost of the work, a special appropriation having been made to the Association by the United States Rubber Company for this purpose.

The beautification of the right-of-way, details of lighting and other final touches under the direction of Mr. Jens Jensen, landscape architect of Chicago, will also be accomplished next Spring, and the section is expected to be finally opened for the inspection of highway engineers and the general public early in the Spring of 1923.

Contracts Awarded

ROADS AND STREETS.

Ala., Huntsville—Williams Bros. Constr. Co., Inc., Roanoke, Va., awarded contract to grade, drain and surface 7,648 mi. Huntsville-Guntersville Rd., Madison Co., F. A. P. 39-A, gravel and penetration surfacing, at $124,056; Stanley & Singer, Lafayette, Ala., awarded contract for 6.87 mi. Decatur—Moulton Rd., Lawrence Co., F. A. P. 19-B, macadam base, penetration top; grade and drain, at $179,278. Both contracts let by State Hwy. Department at Montgomery.

Ala., Jasper—J. W. Gwinn, Birmingham, Ala., awarded contr. by State Hwy. Comn., Montgomery, for 8.99 mi. rd. in Walker Co., from Jefferson Co. line to Warrior River, at $168,851.

Ark., Osceola—Gregory & Wilson awarded contract by St. Dept. at Little Rock, for 11 mi. asph. road from Wilson to Osceola, at $400,000.

Cal., Brawley—W. F. Beal, Brawley, awarded contract for paving approx. one mile city streets, at $90,800.

Cal., Hemet—George R. Curtis, 2440 E. 26th St., Los Angeles, awarded contract for impvt. of Buena Vista St., Juanita St., Central, Acacua and other avenues, at $74,510.

Cal., Lindsay—Clark & Henery Constr. Co., 38 S. Sutter St., Stockton, awarded contract for impvt. of various streets here, at $125,412.

Cal., Newport Beach—California Constr. Co., Union Bldg., San Diego, awarded contract for paving Central Ave. and other streets, at $404,622.

Cal., Riverside—Warren Constr. Co., **Oakland**, awarded contract for paving road bet. Mecca and Thermal in R. I. D. No. 10, at $164,687.

Cal., Sacramento—H. H. Peterson, Loma Portal, Cal., awarded contract for paving 7.77 mi. state hwy. in Los Angeles and Orange Cos.—Long Beach to Huntington Beach, with 6-in. cement conc., at $227,394.

Cal., San Francisco—Eaton & Smith, 407 11th St., awarded contract for improving Collingwood St., 21st to 22nd Sts., at $70,000.

Cal., Santa Ana—A. R. Ford, 407 W. 17th St., Santa Ana, awarded contr. for improving portion of Bristol St., at $53,769; involving 185,332 sq. ft. 6-in. conc, paving at 22.75c ft., 3226 lin. ft. curb at 40c ft., 1546 ft. house sewers at 40c ft., 210 ft. 6-in. main sewer at 60c ft., 21 ft. 10-in. main sewer at $1 ft., 4820 ft. comb. curb and gutter at $1.95 lin. ft., 276 ft. 20-in. curb at 55c ft.

Ga., Dahlomega—T. W. Ellis, Ellis Bldg., Macon, awarded contr. for constr. of 6.8 miles rd. connecting with Cleveland-Blairsville Rd., F. A. P. 285, at $103,000; State to furnish cement.

Ky., Frankfort—Following contracts let for road work in state; Hatfield Constr. Co., road work in Carter Co., at $111,521; Ping Bros. Constr. Co., Somerset, Ky., Greensburg-Hodgensville Rd, Green Co., 5.4 mi., (conc. pipe), at $49,683; Metzel, O'Hearn, Vastine and Lewin, 12.8 mi. Barbourville-Pineville Rd., Knox and Bell Cos. (rock asph.), at $338,398; Hatfield Constr. Co., Huntington, W. Va., 9.7 mi., Morehead-Grayson Rd., Carter Co.; Haynes, Duncan & Priest, Henderson, Ky., 4.2 mi., Louisville-Paducah Rd., Daviess Co., at $21,847; Billiter & Oliver Bros., Covington, Ky., 5.1 mi. Lexington-Covington Rd., Boone Co., at $158,462; Vermillion Contg. Co., Barbourville, Ky., 10.2 mi. Stanton-

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Compton Rd., Wolfe Co., at $81,686; Codell-Byars Constr. Co., Winchester, Ky., 8.1 mi. Stanton-Compton Rd., Powell Co., at $153,787; to same contractor, 2.1 mi. Perry Co. Hazard-Whitesburg Rd., at $87,061; Alexander Bros. 2.9 mi. Trigg Co., Cadiz-Hopkinsville Rd., at $51,329; R. B. Tyler Co., Louisville, Ky., 13.9 mi. Camp Knox-Elizabethtown Rd., Hardin Co.

Ky., Grayson—Hatfield Constr. Co., Huntington, W. Va., awarded contract by St. Hwy Comn., Frankfort, for rd. impvt. on Midland Trail, Carter Co., bet. Ashland and Lexington, at $125,000.

Ill., Waukegan—Liberty Engrg. and Constr. Co., 4238 Grand Blvd., Chicago, awarded contract for paving Sex. X-15 D, Grand Ave., from Gurney, westerly to Lake Villa Rd. (Portland cem. conc.), at $97,863.

Ind., Indianapolis—Highways Impvt. Co., South Bend, Ind., awarded contract for F. A. No. 38, Laporte Co., 5.077 miles, bit. macadam No. 1, at $109,017.

Ind., Indianapolis—Following contracts let for street and alley paving, amounting in all to $59,075; portion of Newton Ave., asph. conc. to Marion Co. Constr. Co., at $17,581; paving Spruce St., asph., to same contractor, at $9,280; Carrollton Ave., asph., to American Constr. Co., at $10,184; Linwood Ave. asph. Union Asphalt Constr. Co., $11,320; 1st alley so. of Woodlawn, W. C. Halstead, at $3,995; 1st alley w. of Illinois St., W. C. Halstead, $5,157; 1st alley no. of Ohio St., W. C. Halstead, at $1,558.

Ia., Davenport—Central Engrg. Co., 811 Putnam Bldg., awarded contr. for grading and conc. paving F. A. P. 185, River to River Rd., Type A conc., at $153,099; F. A. P. 54, Davenport-Durant Rd., Type A conc., at $155,904; Sec. B. Div. 9, F. A. P. 55 Davenport-Harrison St.—New Liberty Rd., Type A conc., etc., at $228,279; Sec. C. Div. 4, F. A. P. 55, Type A conc., etc., at $144,486; Thompson & McDaniel, Wapello, grading F. A. P. 185, $14,385.

Ia., Decorah—J. A. Dunkel, Webster City, award. contract for grading, draining etc., F. A. P., 98, Winneshiek Co. earth excav. 109,536 c. y., 27½c per c. y.; loose rock, 75c; solid rock, $1.50; J. A. Dunkel also awarded contract for P. R. P. 121, 23,798 c. y., 26c per c. y.; Louis Moe, Belmond, 12,235 ft. 6-in. tile drain, 12.4c per ft. 3 type B intakes at $18 each. 2,811 miles from Calmar toward Decorah.

Md., Baltimore—State Rds. Comn., Baltimore, let contracts for paving as follows: Contr. C1-31, to Thomas, Bennett, & Hunter, Westminster, $84,098; Contr. BC-42 to Baltimore Asph. Blk. & Tile Co., 1320 N. Monroe St., Baltimore, $33,950; Contr. P-39 to G. B. Mullen, 1296 Upshur St., Wash., D. C., Mechanicsville, $16,037; Contr. D-28 to Holt Constr. $121,348; Contr. Sm. 21, St. Mary's Constr. Co., Co., Federalsburg, at $34,934. Bd. of Awards let contracts for grading, curbing and paving with sheet asph. 1½x1½, 1-3-6 conc. base, Lombard, Harvey, Wolfe and Ann Sts., East Ave. and Calverton Rd., to P. Flannery & Sons, Harford Rd. and 25th St., Baltimore, $74,767.

Mich., Lansing—Following state trunk line contracts awarded: Rd. 24-17 A. & B., Newaygo Co., Cl. A gravel, 16 ft. wide, 1,506 miles, to Houlding & Son, Lakeview, Mich., at $9,767; Rd. 54-6 D, Newaygo Co. Cl. A gravel, 1,504 mi. to Pierson & Allswede, Hersey, Mich., at $10,549; Rd. 3201 D, Montmorency Co., Cl. B gravel, 1.855 miles to Louks & Fenton, Whittemore, Mich., at $27,315; Rd. 11-4, D, Ottawa Co. Cl. F conc., 20 ft. wide, 0.540 mi. to Townsend-Shuttleworth-Ballmer Co., Lansing, at $10,702; Rd. 11-4, D, est. cost cement, $5,304; 39-8, Kent Co. 12 ft. culvt. to Todd & Montgomery, Sparta, at $1,962. Fed. Aid contracts let as follows: Rd. F. A. 91, Berrien Co. New Buffalo Twp. Cl. F conc., 18 ft. wide, 1.281 mi., to Municipal Contracting & Supply Co., Gary, at $25,368; F. A. 91, Berrien Co. est. cost cement, $10,642; R. 45 B-3, Ingham Co., City of Lansing, Cl. F (asph. conc.) 20 ft. in width, 0.315 mi. to County Rd. Commrs. Mason, at $10,937.

Mich., St. Ignace—Following contracts let for road work in Mackinac Co.: 1-F. A. P. 80, Secs. A & B, to S. J. Groves & Son, 120 Manhattan Bldg., Duluth, at $18,660; Newton & Garfield Twps. Grav. 12,062 miles, width 18 feet; Sec. Regan-Baker Co., Kewatin, at $113,483, Hendricks Twp., 12,366 mi., width 18 ft.

N. Mex., Roswell—New Mexico Constr. Co., Albuquerque, awarded contract for grading, curbing, guttering and paving various streets, at $170,000.

N. Mex., Santa Fe—Following projects awarded to low bidders: F. A. P. 75, McKinley Co., 26.18 mi., bet. Guam and Bluewater, to O. C. McElrath Constr. Co., Mesa, Ariz., at $137,007; F. A. P. 84, Grant Co., 21.082 mi., bet. Cliff and Mogollon, to Chas. A. Cunningham, Reserve, N. M., at $137,055; F. A. P. 90, Santa Fe Co., 4.259 mi., bet. Pankey's Gate and Canoncita, to Peterson, Shirley & Gunther, Omaha, Neb., at $47,303; F. A. P. 95, Torrance Co., 10.180 mi., bet. Willard and Lucy, to McClure & Dobson, Magdalena, New Mexico, at $44,031.

Mo., Kennett—J. W. Carmean, W. P. Robertson and B. O. Bennett awarded contract by St. Hwy. Dept. for 6.58 mi. St. rd. so. from Kennett toward Senath; conc., at $149,942.

Mo., Albany—E. L. Meek & Co., Kans. City, Mo., awarded contract by St. Hwy. Dept. for 3.680 mi. State rd. from King City to Stanberry; penetration macadam, Gentry Co. F. A. P. No. 54, at $82,691.

Mont., Missoula—H. H. Boomer, Spokane, Wash., awarded contract for Wolf Lodge-Squaw Bay road bldg. project, 4.83 miles, at $117,274. The 1,400 ft. trestle contract for Squaw Bay crossing awarded to A. B. Lefferty, Coeur d'Alene, Idaho, at $22,862.

N. Y., Mamaroneck—J. Dimando, Inc., local, awarded contract by Bd. Supvrs., Westchester Co., courthouse, White Plains, for impvt. of Mamaroneck Ave., from Washington Sq. no. to County Hwy. 1581 here ,at $90,554.

N. Y., St. George—Brooklyn & Manhattan Contg. Corp. 26 Court St., Brooklyn, awarded contract for repaving Southfield Blvd., etc., with conc., at $178,580; J. E. Donovan, 2205 Richmond Terrace, Pt. Richmond, contr. for impvt. of Washington Ave. and roadway of Henderson Terrace, Pt. Richmond, at $20,625 and $26,401, respectively.

Pa., Ebensburg—J. L. Elder, Ebensburg, awarded contract for 22,421 ft. Old Plank Rd., Cambria Twp., brick surface on conc., at $252,436.

S. C., Charleston—Simons-Wayrant Co., Charleston, awarded contract for 9,55 miles conc. highway from St. John's Isl. turn-off to Atlantic Coast Line crossing, beyond 21-mile post, St. Andrew Parish, at $283,532.

S. C., Union—Southern Paving & Contracting Co., awarded contr. to improve streets at $150,000.

Tex., Brownsville—E. P. McElwrath, Corsicana, Tex., awarded contract for paving following roads: 10.48 miles conc. rd. on State Hwy. No. 12; 10.32 miles conc. rd. on St. Hwy. No. 12, bet. Harlingen and Hidalgo Co. lines, $681,206.

Tex., Coleman—Womack Constr. Co., Sherman, awarded contract, grading and gravel surfacing 17.42 mi. St. Hwy. 7, F. A. P. 194, 16 ft., at $135,857.

Va., Newport News—Gannaway & Hudgins.

Va., Richmond—State Hwy. Dept., Richmond, let awarded contract for paving at $123,000.
contract for conc. paving 6.43 mi., Richmond-Petersburg Turnpike—Falling Creek to Dutch Gap—to C. M. Henley, 23 S. Beach St., Richmond, at $170,734; 6.27 mi. Louisa Rd., west, 22 ft., to L. R. Colbert, Richmond, at $109,590.
Va., awarded contr. for 5.01 mi., 16 ft. bitum.

Va., Richmond—Pardee-Gillespie Co., Fairfax, macadam hwy. from Chantilly to Loudon Co. line. Fairfax Co., proj. 168, Route No. 6, at $134,876.

Wash., Olympia—K. L. Golder, Ilwaco, Wash., awarded contract for 12.21 miles clearg. grading, draing. and surfacg. with crushed rock in Klickitat Co. along no. bank of Columbia River, at $334,135; Grant-Smith Co., Henry Bldg., Seattle, awarded contr. for clearg. grading and draing. 20.51 mi. Inland Empire Hwy., bet. Yakima and Umptanum, Kittitias and Yakima Cos., at $556,-739. Pioneer Sand & Gravel Co., Seattle, offered best bid for placing sand and gravel along Pacific Hwy. in accord. with Hwy. Department's specifications.

Wash., Spokane—Sloan Constr. Co., city, awarded contr. for 7½ miles hard surfaced highway (Hope-Pack River section of Kootenai-Cabinet Hwy.), at $171,000.

W. Va., Welch—W. Sudduth, Bluefield, awarded contract for surfacing with rock asph. Proj. 2166, at $219,725; 5½ mi. Proj. 2168 to Albert Bros., Charlottesville, Va., at $200,400.

W. Va., Wheeling—Federal Asphalt Co. awarded contract for paving 3rd St., city, at $116,144; Fred Amrine, Brookside, awarded contract for impvt. of Sand Hill-Neff road; 8-in. sandstone base, 4 ins. slag and a thickness of Tarvia.

Wyo., Casper—Levy Construction Co., Denver, Colo., awarded contract for 18 miles road work, 9 ft. wide, 6-in. conc. base and 2-in. black top, at $516,862; Peck & Cain, Riverton and Lander, awarded contract for grading 9 miles rd. in Fremont Co., Crowheart to Circle; bridge contract (3 steel brdgs.) to J. F. Turpin, Wheatland, $59,000.

SEWERAGE AND SEWAGE TREATMENT.

Ala., Gadsden—Sullivan, Long & Haggerty, Bessemer, awarded contract for approx. 18 miles san. sewers in No. Gadsden and Oak Pk. addn., at $66,143.

Cal., Compton—Claude Fisher, 610 Wright & Callender Bldg., Los Angeles, awarded contract for constr. of sewer sys., comprising 8636 ft. 6-in., 44,969 ft. 8-in. and 981 ft. 12-in. vit. pipe sewer, including 180 manholes, house sewers, etc., at $59,378.

Cal., Delano—Constr. of sewers let to Stroud Bros., 210 Union St., Bakersfield, 1 rein. conc. settling tank, $7,000; 2 sludge beds with roadways, 200 ft. drain, $252; 3,978 lin. ft. 24-in. conc. pipe sewers, $2.34; 434 lin. ft. 18-in., $1.86; 18,227 lin. ft. 15-in., $1.44; 9131 lin. ft. 12-in., $1,245; 9,961 lin. ft. 10 in., $1,085; 38,775 lin. ft. 8-in., $0.92, etc. Total, $119,000.

Cal., Glendale—Cox & Teget, 222 Harvard Pl., Ontario, awarded contract for constr. of Verdugo Canyon sewer laterals, at $45,399.

Colo., Denver—J. E. Young, 1267 S. Race St., awarded contract for Washington Park storm sewer dist. 169.78 in. and segment blk., 27-66 in. brk, and 10-24 in. conc. pipe, at $334,107.

Ind., Indianapolis—Following sewer contracts let: Warman Ave., sewer to Columbia Constr. Co., at $9,496; Drexel St., same contractor, at $8,094; Mount St., to same contractor at $3,501; Sheffield Ave. sewer to Sheehan Constr. Co., at $8,816.

Kans., Kansas City—T. M. Torson Constr. Co., 73rd St. and Metropolitan tracks, awarded contract for 2 mi. storm sewers for Armourdale, 6 ft. diam., flood gate and force pump; engineer's est., $145,000.

Kans., Wichita—A. A. Dobson, 802 1st Natl. Bldg., Lincoln, Neb., awarded contract for excav. and laying sewer pipe in segmental blk., at $190,158.

Mich., Detroit—J. Wagner, 2735 W. Grand Blvd., Ryan Ave., arm ser., mile road sewer, $48,602; R. D. Baker, 1631 Elmhurst Ave., Fenelon Ave., arm of 7-mile rd. sewer, $37,286; Connelly Bros., 2269 Hamilton Ave., Edison Ave., arm, at $58,260; Westminster Ave., arm Bates St. sewer, $49,690; C. R. Lennane Co., 2631 Woodward Ave., Huston Ave., arm of Gratiot Ave., sewer, at $41,264.

Mich., Lincoln Park—(Wyandotte P. O.)—Callahan & Grosse, Lincoln Park, awarded contract for 8,030 ft. 8-48 in. vit. crock sewer in Emmonds Blvd., at $38,192.

Mich., Springwells—Contr. for bldg. 3447 ft. Sec. 10, main trunk sewer, to Detroit Draing. Constr. Co., 5099 Lemay Ave., Detroit, at $65,578; 5088 ft. Sec. 14, main trunk sewer, to J. Porath, 745 Griswold St., Detroit, $103,677; grading Schaffer Rd. to Closser Bros., 8427 Stencfor Ave., Detroit, at $14,059.

Minn., Eveleth—Laurence McCann Co., Eveleth, awarded contract for sewer disposal plant, etc., at $75,000.

Mo., Cape Girardeau—J. J. Dunnegan, Shenandoah, Ia., awarded contract for contstr. of sewer system; 16 miles of sewers from 8-in. to 102-in. in diam., at cost of $352,000.

N C., High Point—H. D. Berry, Bessemer, Ala., awarded contract for sewerage work at approx. $75,000.

N. Y., New York—Spadaro Contg. Co., 827 E. 217th St., awarded contr. for sewer in Webster Ave. at $518,984; paving with sheet asph. W. 190th St., etc., to C. D. Beckwtih, 2875 Broadway, at $7,979.

Ohio, Marion—A. Bentley & Son Co., 201-31 Belmont Ave., Toledo, awarded contract for sewage plant at $435,000; Kohlbarger & Hoyles, Marion, contract for sewerage system at $16,316.

Ohio, Marion—Kobarger & Noyles, Marion, awarded contract for construction of trunk line sewer at $78,809.

N. C., Taylorsville—Electrical Constructors Co., 508 W. 4th St., Charlotte, awarded contract for constr. of sewerage and water works systems at $63,418.

N. H., Manchester—T. Stuart & Sons Co., 222 Pearl St., Newton, awarded contract for rein. monolithic culvert outfall sewer, all connections, at $189,000.

Ohio, Cleveland—Contracts for sewers in Carnegie Ave. to D. Zullo, 10501 Hudson Ave., at $10,671; Aspinwall Ave. and Saranac Rd., also Pearl Rd., relief sewer to Manson Co., 335 The Arcade, $27,967 and $58,042, respectively; Roseland Ave. to Hadded-Hall Co., Schofield Bldg., at $16,720.

Ohio, Columbus—Following contracts let: Vit. sewer in sewer dist., Clinton 2, Contr. 13, to Gangl Constr. Co., 737 2nd Natl. Bldg., Akron, $55,929; Sewer Dist. Clinton 2, Contr. 12, to C. F. Smith, 54 Davies St., Dayton, $12,163; vit. or conc. sewer in Sewer Dist., Marion 1, to W. Neilson, 1616 Summit St., at $18,721.

Okla., Paul's Valley—V. V. Long & Co., Okla. City, Engrs., preparing plans for storm sewers and paving to cost $50,000 to $100,000.

Pa., Altoona—Bell Bockel Co., Inc., Central Trust Bldg., awarded contract for 14,00 ft. terra cotta and concrete sewer pipe, etc., at $51,149.

Pa., Philadelphia—Jackson & Co., 119 S. 4th St., awarded contract for sewage disposal plant, 40th Ward, at $153,900; mechanical equipt. to Sanitary Corp., 165 Bway., New York City, at $49,000.

Pa., Pittsburgh—Following sewer contracts let: Edgerton Ave., John E. Born, at $2,589; Bernard St. Frank, Mannella, $2,364; Wightman St., F. Mannella, $2,179; Shady Ave., Mannella Bros., $2,510; Orchlee Ave., F. Mannella, $4,329.

Tex., Fort Worth—McKenzie Constr. Co., San Antonio, awarded contract for constr. of sewage disposal plant on Trinity River, at $699,990.

Wis., Ellsworth—Camden Constr. Co. (J. B. Camden), Benson, Minn., awarded contract for pipe sewers at $30,732; W. C. Ottman and F. H. Johnson, Ellsworth, contract for disposal tanks Nos. 2, 3 and 4, at $8,961, $4,933 and $3,048.

WATER SUPPLY AND PURIFICATION.

Cal., Santa Barbara—U. S. Cast Iron Pipe & Foundry Co. awarded contract for furnishing water pipe at about $50,000.

Ont., Alvinston—Goldie & McCulloch, Galt, awarded contract for installing new electrically operated water works pumps; engr.'s est., $250,000.

Quebec, Montreal—Laurin & Leitch Eng. & Constr. Co., 590 Union Ave., awarded contract for 11,000 ft. 40-in. steel force mains from pump. sta. to Atwater and Sherbrooke Sts., and 2,000 ft. 30-in. steel force main in Sherbrooke St. from Atwater to Oliver Sts., at $500,000.

Ont., Port Credit—Turbine Equipment Co., 73 King St., W. Toronto, awarded contract for pumping equipt. for pump house; hydrants to Dominion Steel Products Co., Brantford, Engrs. Ttotal est., $45,000.

Fla., Haines City—J. B. McCrary Co., 3rd Natl. Bank Bldg., Atlanta, awarded contract for water works and san. sewerage systems, at $60,500.

Kans., Morrill—Hybskman & Wiley, Seneca, awarded contracts for water works and sewerage systems at $22,770 and $21,829, respectively.

Ill., Jerseyville—C. M. Hanes, Jerseyville, awarded contract for 34,320 ft. 10-in. mains, 1 sty. 26x36 ft. stone pump house, rein. conc. reservoir, 1,000,000 gal. capy., pumps, etc., at $215,740.

La., Alexandria—A. M. Lockett Co., New Orleans, awarded contract for steel pipe; Standard Sanitary Mfg. Co., New Orleans, contract for valves, jute and lead wool; U. S. Cast Iron Pipe & Foundry Co., Burlington, N. J., cast iron pipe. Will call new bids for laying mains. Cost, together with gas distribution plant, $360,000.

Minn., St. Paul—St. Paul Water Dept. will do following work by day labor. Construct high serv., rein. conc. reservoir for new water works plant, 18,000,000 gal, capy.; inside dimensions, 306x414 ft., 20 ft. deep, groined arch flr. and flat slab roof, rein. conc. retaining walls, 14,000 c. y conc. and 600 tons steel. Est. cost, $200,000. J. W. Kelsey, Supt. Water Dept.

Neb., Omaha—Worthington Pump & Machy. Corp., 37 W. VanBuren St., Chicago, awarded contract for 50,000,000 gal. pump for Florence Water Sta., at $40,600.

N. C., Greensboro—Pittsburgh-Des Moines Steel Co., Southern office, Richmond, Va., awarded contract for constr. of filtration plant at $107,015.

Ohio, Cleveland—T. P. Egan, Caxton Bldg.,

awarded contract for 18,460 lin. ft. cast iron mains in impvt. 16 of Cuyahoga Co. Water Dist. at Parma, at $78,853.

Ohio, Sebring—E. J. Landor, Renkert Bldg., Canton, awarded contract for water purification plant at $41,270.

Ohio, Steubenville—Federal Asph. Co., Hamilton, awarded contract for furnishing 127 tons Cl. C cast iron pipe, f. o. b. Steubenville, at $116,145.

Okla., Tulsa—Following contracts totaling $5,492,322 let by Water Commrs. for spavinaw water enterprise: No. 1, constr. of 60 miles telephone line, Tulsa to Spavinaw, at $11,606, to Vinita Elec. Co.; 2 Clearg. site Spavinaw Lake, at $20,250 to Standard Paving Co., Tulsa; 3 Spavinaw Dam, at $787,610 to Standard Paving Co., Tulsa; 4, constr. of 60-in. pipe line from dam to tunnel at $2,136,980 to Wallbridge-Aldinger Co., Detroit, Mich.; 5, constr. of tunnel at $304,057 to Standard Paving Co., Tulsa; 6, constr. of 54-in. pipe line from tunnel to Mohawk Reservoir, at $1,715,160 to Wallbridge-Aldinger Co., Detroit; 7, constr. of Mohawk Reservoir, 500,000 gal. capy., at $105,956, to R. M. Davies & Sons, Tulsa; 8, furnishing 36-in. cast iron pipe, $210,792, to U. S. Cast Iron Pipe & Foundry Co., Burlington, N. J.; 10, laying c. i. pipe from high pressure reservoir to city, at $49,358, to Standard Paving Co., Tulsa; 11, high pressure reservoir, no. of city, at $150,553, to Traylor-Dewey Contg. Co., Allentown, Pa.; Trammell & Holway, Engrs., 1446 Monadnock Bldg., Chicago.

S. D., Rapid City—Plans prepared for constr. of municipal water works system, $175,000, bonds issued.

Tenn., Memphis—D. D. Thomas & Son awarded contract for constr. of reservoir and sub-struct. of water plant at $527,000. Will open bids in November for constr. of superstructure.

Utah, Ogden—F. W. Spencer Co., State St., Salt Lake City, awarded contract for furnishing and laying 550 tons cast iron pipe, valves, etc., at $49,202.

W. Va., Parkersburg—Chamber of Com. interested in impvts. to water supply. Est. cost about $150,000. Layne & Bowler, Engr., Cincinnati.

Prospective Work

ROADS AND STREETS.

Ala., Dothan—Bureau of Public Rds., Montgomery, Ala., contemplates bldg. 21.55 mi. Bee Line Hwy., Houston Co., from Dale Co. line to Florida line through County.

Ala., Oneonta—Blount Co. plans to construct 16 mi. rd. bet. Village Springs and Oneonta; bids in about 30 days.

Ark., Pine Bluff—Good Roads Comm., Chamber of Commerce, W. J. Parkes, Chrmn., has tentative plans for rebldg. 100 miles main highways leading out of Pine Bluff, including Dollarway from Pine Bluff to Pulaski Co. line, and Tampo Pike from Pine Bluff to jct. with Ark.-La. highway. Est. cost, $2,000,000.

Cal., Fresno—City Engr., Wm. Stranahan, has completed plans for impvt. of Welden Ave. bet. VanNess Ave. and east city limits, involving 75,830 sq. ft. grading, 58,165 sq. ft. asph. paving, 5,260 sq. ft. conc. gutter, 6,630 sq. ft. conc. walk, 1,340 ft. curb, 272 ft. 12-in. culvert, 44 ft. 18-in. culvert, 7 manholes.

Cal., Santa Monica—Commr. Wm. H. Carter states that city contemplates expending over $1,100,000, exclusive of proposed $1,200,000 bond issue, to open Trolleyway, Main and other streets.

Fla., Jacksonville—Duval Co. Commrs. plans improving following: 10.38 mi. rd. from end of present perm. hwy. on King's Rd. to County line through Dinsmore; 12.83 mi. rd. from end of present perm. hwy. to Nassau River toward Yulee; 8.25 mi. rd. from city limits to Co. line through Ortega; 20.02 mi. rd. from S. Jacksonville city limits to Co. line through Hollywood, connecting with St. Augustine rd. through Bayard; 8 miles rd. from Baldwin to Co. line through Maxville; two one-way roads on Beach road, utilizing present Beach rd. for one, and So. Jacksonville to Pottsburg Crk. right-of-way for other; 15 miles hard surf. rd. from Neptune to Pablo Beach and from Neptune to Atlantic Beach. C. S. Coe, Co. Engr.

Fla., Plant—City considering paving Baker St. Voted Oct. 31 on $55,000 bonds; construct storm sewers. Voted Oct. 31 on $10,000 bonds.

Fla., Sebring—Highlands County having preliminary plans prepared for surfacing 5 or 6-in. rock on 5-mile rd. from Sebring via O'Berry's to Hardee Co. line, $25,000; surfacing with conglomerate material to be dredged from canal, 18-in. thick; 23-mile rd. from Lake Annie to Kissimmee River, $200,000; grading and claying with probably 5 to 10-mile fill; 30-mile rd. from DeSoto City or Sebring to Bassenger; 6-in. compacted rock base and probably asph. surf.; 45-mile rd. from Polk Co. to Glades Co. via Avon Park, Sebring, Venus, etc., $300,000. W. C. Peacock, Sebring, Engr.

Fla., W. Palm Beach—Palm Beach Co. Commrs., H. Harris, Chrmn., considering impvt. of following roads: 17 miles from Belle Glade to Lee Co. line, $221,000; 20½ mi. from bend in W. Palm Beach Canal to Canal Point, $225,000; 1½ mi. from Gladcrest to cross state hwy., $16,500; 8½ mi. from Kramer Island to Belle Glade, $126,000; 8½ mi. from Pahokee to Kramer Island, $127,000; 2½ mi. Bacom's Pt. to connection with Pahokee Rd., $35,000; 6¼ mi. from Gardenia to connection with cross-state rd. on bank of Miami Canal, $71,500; 9 mi. from Okeelante to Gladcrest, $78,000; Military Trail, Lake Worth Rd. and brdg. over W. Palm Beach canal, $35,000.

Ga., Brunswick—St. Simons Hwy. Dept., showing approx. cost of constr. of highway to St. Simons from Brunswick. Est. cost, $300,000.

Ill., Springfield—Mr. Clifford Older, Chief Hwy. Engr., states that Hwy. Dept. is ready to complete plans and surveys on DePue-Spring Valley section, and also on Princeton-DePue section of the Ivy Way hard road, Bureau County.

Ind., Indianapolis—State Hwy. Dept. plans to hard surface 11.2 mi. State Rd. 6, Marion Co.; 8 mi. St. Rd. 10, and 7 mi. St. Rd. 4, Vanderburg Co.; 11.5 mi. St. Rd. 1 St. Joseph Co.; 26 mi. St. Rd. 1, Jackson Co.; 12 mi. St. Rd. 2, Allen Co.; 24 mi. St. Rd. 1, Hamilton Co. All 16-ft. C. Gray, State Engr.

Ky., Frankfort—McCreary County has offered to put up $200,000 of recent bond issue for work on Dixie Air Line in County. Commission has accepted offer.

La., Bastrop—Morehouse Parish Police Jury contemplates bldg. 143 miles of roads. Vote Dec. 16 on $1,150,000 bonds. Rd. Dist. No. 1 on $329,700; Rd. Dist. No. 2, on $820,300.

La., Jennings—City will pave and gravel certain streets; $135,000 bonds voted.

La., Lake Charles—City considering public utilities and public impvts. to cost $2,000,000. J. A. Trotti, Mayor, Impvts. will consist of street paving, increased water supply and impvts. to traffic conditions.

La., Leesville—Vernon Parish Police Jury will improve rds. in Dist. No. 6; $370,000 bonds voted.

La., New Orleans—City considering $3,227,352 expenditure for street paving, including Apple, Audubon, Baldwin, Burthie, Bayou, Cadiz, Carrolton, Carondelet, Constance, Dauphine, Dufossat, Elenore, Fontainbleau Drive, Governor, Nicholls, etc., etc.

Michigan—Emmett County plans to construct 38½ miles gravel road in 1923, also several miles conc. pavement on main trunk lines by county and state. Gravel rd. will be 10 mi. on Center pike, 2 mi. no. of Pellston, w. 6½ mi. on Pleasant View pike, no. from nr. Sexton's cors. and 22 mi. on Shore Drive to Cross Village. Conc. pavement will be on so. entrance to city leading to Mitchell St. and w. leading down Charlevoix Ave., Jackson to Mitchell. Mile conc. pavement through Allanson will be built and rd. through Harbor Springs completed. Mr. Tripp, Engr., Oakland County, will get 16 mi. new conc rd. in 1923 if plans of State Hwy. Dept. are carried out, as announced by L. V. Belknap, Oakland Co. Hwy. Engr. Extensive rd. bldg. program will be carried out in Monroe Co. if State Legislature will authorize sale of $10,000,000 worth of rd. bonds, in which County will share. Tentative program includes constr. new Dixie Hwy. bet. Monroe and Stony Crk., 1.5 mi. long and 20 ft. wide; F. A. P. No. 73 and new section Ida-Bedford Rd., in Monroetown, LaSalle, Erie and Bedford Twps.; F. A. P. 42, 14.5 mi. (gradg. brdgs. and culverts) cost $100,000. New sect. Ida-Bedford

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Co.

Air Lift Pumps.
Harris Air Pump Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Bitoslag Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
The Barrett Co.
Bitoslag Paving Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
The Barrett Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Cummer & Son Co., The F. D.

Asphalt Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

Asphalt Railroad Plants.
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Tools.
Littleford Brothers.
Warren Bros. Co.

Asphalt Tool Wagons.
Littleford Brothers.

Auto Fire Apparatus.
Diamond T Motor Car Co.
Duplex Truck Co.
Garford Co., The.
Kissel Motor Car Co.
International Motor Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Back Fillers.
Austin Machinery Corporation.
Pawling & Harnischfeger.

Bar Cutters and Benders.
Koehring Machine Co.

Bars, Reinforcing.
Truscon Steel Co.

Binders, Road.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros Co.

Blasting Accessories.
E. I. du Pont de Nemours & Co., Inc.

Blasting Powder.
E. I. du Pont de Nemours & Co., Inc.

Bodies.
Lee Trailer and Body Co.
Littleford Brothers.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling & Harnischfeger.

Buckets, Dumping.
Littleford Brothers.
Pawling & Harnischfeger.

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement Testing.
Kirschbraun, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Central Heating Plants.
American District Steam Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.
Littleford Brothers.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.
Littleford Brothers.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L., The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Carey Co., Philip, The.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Conduits, Wood, Creosoted.
Republic Creosoting Co.

Consulting Engineers.
Alvord, John W.
American Appraisal Co.
Artingstall, Wm.
Brossman, Chas.
Burd & Giffels.
Chicago Paving Laboratory.
City Wastes Disposal Co.
Dow & Smith.
Fargo Engineering Co.
Flood, Walter H., & Co.
Gannett, Seelye & Fleming Co.
Hill, Nicholas S., Jr.,
Howard, J. W.
Hunt & Co., Robert W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Luten, Daniel B.
Morse, Wm. F.
Potter, Alexander.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L., The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling & Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Austin-Western Road Machinery Co.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Direct Oxidation Process.
Direct Oxidation Process Corp.

Disinfectants.
Integrity Chemical Co.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg Co., W. E.

Drawing Materials.
Kolesch & Co.

Dryers.
Cummer & Son., The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

Rd. will cost $150,000 and run from Samadia to state line, 5 miles. 16 miles Chicago turnpike and grading and draing. of eastern 15 mi. is contemplated by State Hwy. Dept., Lansing. State also planning to build 2 mi. ont runk line No. 80, bet. Adrian and Rome Center.

Mass., Boston—State Hwy. Dept. contemplates paving 5700 ft. rd., 18-ft. from Ware to Enfield, Hampden Co., 34,200 sq. yds. conc. $75,000 State Bd. Pub. Works, State House, Boston, Engrs.

Miss., Mayersville—Issaquena Co. contemplates constructing greater part of Mississippi River Scenic Hwy., no. of Warren Co.; $230,000 bonds voted.

Miss., Senatobia—Tate County Supervisors plan constr. of 12 miles of Jefferson Davis Hwy. through County. Est. cost $100,000. Will request $80,000 Federal aid.

N. Y., Bath—Steuben Co. plans paving 4 miles Hornell-Loon Lake Rd., $155,000; 5.25 mi. Hammondsport-Branchport Rd., $308,209; 4.5 mi. Lawrenceville Rd., $231,500, asph. conc. or brick. Engineer not announced.

N. C., Hillsboro—T. M. Arrasmith, Mayor, will pave 1 mile of street concrete with sheet asph. finish; $60,000 bonds voted for impvt.

N. C., Wilmington—Commr. of Pub. Wks. R. C. Cantwell contemplates 80,000 yds. street paving, asph. and brick, $200,000. Carolina Engrg. Co., Engr,. Wilmington.

Ohio, Dayton—Montgomery County considering paving 4 miles Dayton-Greenville Pike; also 4 miles Germantown-Middletown Pike, 18-20 ft., 90,000 sq. yds. conc or brick; $160,000. W. O. Pease, Co. Surv.

Pa., Clarion—Commrs. of Clarion Co. and others considering improvement of road from Venus to Fryburg at cost of $100,000. New Castle plans to widen Mercer, Mill, North and Neshannock streets from 60 to 75 ft. at cost of $25,000.

S. C., Spartansburg—State Hwy. Comn., Columbia, considering constr. of 2 miles hard surf rd. from Arkwright. Est. cost, $70,000.

Tenn., Jonesboro—City and Washington County contemplates following improvements: Repairing 10 or 12 roads in County; macadamizing road from Johnson City to King Springs; placing tile under Adams fill on Blountsville road.

Tenn., Manchester—Coffee Co. preparing plans for constr. of macadam road system; $400,000. N. H. Meriwether, Co. Engr.

Tex., Angleton—Brazoria Co. considering constr. of St. Hwy. 19 through Rd. Dist. 16; St. Hwy. Comn. granted $130,000 aid. C. D. Jessup. Co. Judge.

Tex., Edinburg—Hidalgo Co. plans bldg. 14 miles of road on St. Hwy. No. 12, connecting Brownsville with San Antonio on north and with Houston on east; concrete or asph. surfacing; $600,000. Proj. 301.

Tex., Houston—Harris County Commrs. court plans following: Type B Rds, 3 mi. Katy Rd; 10 mi. Washington Co. Rd.; 10 mi. Spring Rd.; 3 mi. Goose Creek-Cedar Bayou Rd.; 3 mi. Telephone Rd.; 2 mi. Almeda Rd.; 4 mi. Bellaire Blvd.; 2 mi. Westheimer Rd. Awards contingent on passage of $6,000,000 bonds.

Tex., Lufkin—Angelina Co. plans bldg. 13.54 miles 16-ft. gravel rd. bet. Huntington and Zavella, $181,500. John Roberson, Co. Judge; G. R. Abney, Co. Engr. Will receive bids soon.

Texas, McKinney—Collin Co. Commrs. will hard surface 2.16 miles State Hwy. No. 1; $450,000 bonds voted. F. W. Cawthorn, Co. Engr.

Texas, Pearsall—State Hwy. Dept., Austin, has approved plans for 17.2 miles Meridian Hwy., Frio Co.; Pearsall to Medina Co. line; gravel surfacing, bitum. topping, $283,270. J. C. Pranglin, Co. Judge. J. D. Metcalfe, Co. Engr.

Va., Fairfax—State Hwy. Dept., Richmond, Va., will construct 8-mile Lee Hwy. from Broad to Washington Sts., Falls Ch. to Fairfax Courthouse, Fairfax Co., Falls Ch. and Providence Dists. Will vote in November on $275,000 bonds.

Wash., Seattle—Plans completed by King Co. Engr., Thomas R. Beeman, for filling, grading and graveling 2 mi. East Valley road from Auburn so. to Pierce Co. line. As soon as right-of-way releases have been obtained, probably within next 30 days, bids will be asked. Quantities involved in impvt. include 37,812 cu. yds., borrow excav. 7,888 c. y.; 366 ft. 12-in. vit. or conc. pipe; 60 ft. 18-in. pipe; 54 ft. 24-in. and 54 ft. 30-in. pipe.

W. Va., Buckhannon—Upshur County plans to improve roads: Moade Dist., $81,000; Banks Dist., $17,000; Union Dist., $120,000; Warren Dist., $95,000. State Rd Comn. will give 50 per cent aid. Vote in November on bonds.

W. Va., Weston—Lewis Co. Commrs. Court, Freeman's Crk. Dist., plans bldg. hard surf. roads. Will vote on $800,000 bonds.

SEWERAGE AND SEWAGE TREATMENT.

Ont., Sandwich—City plans to extend sewerage system at cost of $25,000. E. R. North, City Engr.

Cal., Los Angeles—City Engr. J. A. Griffin has been ordered by Bd. Pub. Wks. to prepare plans and specs. for 1st 3 units of new $12,000,000 sewage dis; wks. Est. cost of bldg. treat. plant, incinerator, 1-mi. exten. sewer oceanward and incidental items, is $1,450,350.

Ct., Hartford—City plans to extend interceptor sewerage system in Blue Hills Ave. at cost of $34,000. City Engrg. Dept., care Public Works Board, Engrs.

Ill., Astoria—Town making plans for 4 miles sani. sewerage system, including disposal plant, 60,000 gal. settling tank, centrif. pump, 18,480 ft. 8-in. and 2,640 ft. 6-in. vit. clay pipe, 17,000 c. y. excav., etc.; $40,000. W. A. Fuller Co., 1917 Ry. Exh. Bldg., St. Louis, Mo., Cons. Engrs.

Ill., Brookfield—Will advertise for bids about Dec. 1st for mains. Est. cost, $55,000. E. Hancock, 2047 Ogden Ave., Chicago, Engr.

Ill., Elmhurst—Will take bids about Feb. 1st for sewerage system and disposal plant. Cost, $150,000. E. Hancock, Chicago, Ill., Engr.

Iowa, Cascade—Prelim. steps being taken for establishment of sewerage system at approx. $75,000. Survey of town recently made.

Ia., Muscatine—State Engr. has approved plans for sewerage and drain. project in So. Muscatine. Approx. cost to impvts. $100,000.

Ky., Louisville—Construction program, including installation of several sidewalks, sewers and streets in various sections of city, costing $160,000, authorized by lower board of General Council.

Mich., Detroit—City having plans prepared for 1½ miles storm sewer in Bedford Rd., 9 ft. 6-in. diam., 3 ring brk. or monolithic concrete. J. W. Reid, City Engr.

Mich., Grand Rapids—Milton P. Adams, City San. Engr., has completed plans for new sewage disposal plant here. Will submit plan to City Comn. in near future. City Maiager, Fred H. Locke.

Md., Brunswick—City voted $30,000 sewer and street bonds.

Mich., Grosse Pointe—(Detroit, P. O.)—City considering 3,500 vit. crock or segment blk. sewer in Kerby Rd.—Ridge Rd. to Black Marsh Crk.—including 1,750 ft. 36-in., 940 ft. 24-in. and 810 ft. 22-in. pipe. $25,000. R. H. Erly, Engr.

Mich., Royal Oak—(Detroit, P. O.)—Plans being prepared for 17,600 ft. main trunk sewer, including 610 lin. ft. 18-in., 2,250 ft. 15-in., 4.332 12-in., 5.620 ft. 10-in., 2,176 ft. 8-in. and 1,420 ft. 6-in. vit. crock pipe. Hoad, Decken, Shoecraft & Drury, Ann Arbor, Cons. Engrs.

Miss., Corinth—City will soon take bids for 29,000 ft. 8-10 in. vit. pipe sewer in various streets, 85 brick manholes with c. i. frames and covers, 10 tons c. i. pipe with sewer crossing streams, 6,200 cu. yds. earth trenching. $35,000. A. H. Beard, 616 Title Guaranty Bldg., St. Louis, Mo., Cons. Engr.

Mo., St. Joseph—It is proposed to extend Blacksnake sewer 12 ft. in diam. and as cost of $86,000.

Mo., St. Louis—City has under consideration plans for expend'g. $11,000,000 for conversion of River des Pres into closed sewer; also for expending $8,000,000 for following work: Exten. Baden sewer, $450,000; exten. of Wherry Ave. outlet sewer, $160,000; Mill Crk. relief sewer, $2,750,000; Rock Branch, Western exten., $550,000; southern Arsenal relief sewer, $1,100,000; Ferry St. relief sewer, $100,000; reconstr. of 11 outlets to Mississippi River, $300,000; additional street inlets, $150,000. W. W. Horner, Chf. Engr. Sewers & Paving.

N. Y., Dundee—Village plans construction of sewer system at estimated cost of $70,000.

N. Y., Rochester—City contemplates storm, water and outlet sewer in Meriden St. and other thoroughfares. Est. cost, $60,000. C. A. Poole, City Engr.

BUYERS' GUIDE

Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Dynamite.
E. I. du Pont de Nemours & Co., Inc.

Edge Protector.
Truscon Steel Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E. Mfg. Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling & Harnischfeger.
Sauerman Bros.
Smith Co., T. L., The

Expansion Joint Compound.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co.

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Graders.
Austin-Western Road Machin-
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ery Co.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gravel Screener and Loader.
Good Roads Machinery Co., Inc.
Jordan & Steele Mfg. Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Plants, Central.
American District Steam Co.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling & Harnischfeger.

Hoists, Electric .
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.

Hydrants.
The Flower Company.

Incinerators.
William F. Morse.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
The Barrett Co.
Carey Co., Philip, The.
The Texas Company.

Kettles (Portable).
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.

Loaders.
Brown Portable Conveying Machinery Co.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
The Barrett Co.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Co.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
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Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
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International Motor Co.
Kissel Motor Car Co.
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Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry.

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
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The Barrett Co.
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Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

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Warren Bros. Co.

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Pipe Cutters.
W. W. Stickler & Bros.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Mach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
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Littleford Brothers.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Powder (Blasting).
E. I. du Pont de Nemours & Co., Inc.

O., Cleveland—City plans storm relief sewer in E. 65th St.—Euclid to Central Aves. $125,000. R. Hoffman, City Hall, Engr.

O., Cleveland—S. H. Gleinman Realty Co. will soon take bids for storm and san. sewers in Elmwood Park allotment. $40,000. Lander Engrg. Co., Blackstone Bldg., Engrs.

O., Cuyahoga Falls—Plans being made by City Engr. here for entirely new storm water sys. throughout city.

O., Euclid—City considering bldg. sewage disposal plant at cost of $250,000. F. A. Pease Eng. Co., Marshall Bldg., Cleveland, Engrs.

Pa., Carbondale—City contemplates laying surf. sewers on Main St. at cost of $7,000; Maple Ave., $1,370; Copeland Ave., $2,450; Dundaff St., $9,850; Chestnut Ave., $785; 8th Ave., $11,650; Salem Pk., $3,850; Laurel St., $7,900. W. L. Giles, City Engr.

Pa., Scranton—San. sewerage system planned here. Est. cost, $52,763. W. P. Huester, Clk.

S. D., Leola—City will ask bids this winter for sewer system and disposal plant. Engrs. Cory & LeCocq, Aberdeen. Start work in sprinf, $20,000.

Wash., Kelso—Long-Bell Lumber Co., 14th and Kenman Sts., Kans. City, Mo. contemplate constr. of storm and san. sewerage systems; 2 miles 48-in. cast iron pipe. Private plans.

Wis., Birnamwood—Plans being prepared for storm and san. sewers at cost of $25,000. W. G. Girchoffer, Dean Blk., Madison, Engr.

Wis., Eagle River—Plans prepared for san. and storm sewers; also disposal tank. $25,000. W. G. Kirchoffer, Dean Blk., Madison, Engr.

Wis., So. Beloit—(Beloit, P. O.)—Bd. Local Impvts., will soon receive bids for outfall sewer bulkhead, etc., in San Dist. 1, 2½, 3½ and 4-ft. rein. conc. pipe. $78,000. L. A. Parsons, Pres.; R. Butterman, Goodwin Blk., Beloit, Wis., Engr.; G. L. Claussen, 139 N. Clark St., Chicago, Cons. Engr.

Wis., LaCrosse—City considering constr. of trunk sewer extension in 16th St. $50,000. C. Congdon, City Hall, Actg. City Engr.

Wis., West Milwaukee—City preparing plans for bldg. san. sewers in various streets. $30,000 bonds issued. Parsons and Orbert, 216 W. Water St., Milwaukee, Cons. Engrs.

WATER SUPPLY AND PURIFICATION.

Ark., Piggott—$600,000 will be expended by City for constr. of water works system.

Ariz., Flagstaff—Plans being made for new water supply system, including reservoir of 100,000,000-gal. capy. Est. cost, $500,000. Burns & McDonnell, Interstate Bldg., Kans. City, Mo., Engrs.

Cal., Eagle Rock—A $48,000 bond issue will be submitted soon to install new 4-in. water mains, 123 fire hydrants; also $60,000 for sinking 2 more wells, constructing large reservoir on Sagamore Hill and laying 12-in. main in Colorado Blvd. and one in alley west of Central.

Cal., E. San Diego—Election Oct. 30th to vote on $31,000 bond issue for purchase of Fairmount water system which will be remodeled into a municipal system. Cuyamaca Water Co., will construct entirely new pipe line on El Cajon Blvd., bet. Euclid and Van Dyke Aves. Work will start within 90 days. Pipe will be 14-in. steel guaranteed for 15 yrs.

Cal., Inglewood—Voters have authorized bond issue of $57,500 for purchase of water-bearing land and $157,000 for new water equipment and extensions of lines.

Cal., Lakeport—City will construct $75,000 water and sewer systems.

Cal., Orange—Survey of proposed Santigo canyon reservoir proj., under consideration for some time, has been ordered by the Irvine Company and Carpenter and Serrano water companies. Plan calls for reservoir capable of 1,500-in. flow during 200 days. Expense will be borne half by Irvine Company and half by water companies.

Cal., Santa Monica—Commr. Wm. H. Carter announces that $50,000 will be expended on impvts. to water sys., an increase of over 9,000 in population making certain changes necessary.

Ont., Wheatley—Plans being prepared for new water works system. Est. cost, $30,000. Prices desired on all equipment. R. O. Wynne-Roberts, 40 Jarvis St., Toronto, Cons. Engrs.

Ont., Whitby—Plans drawn for slow sand filter and 1,000 ft. extension to cost $54,000. F. W. Thorold, Engr., 54 Admiral Rd., Toronto.

Ont., Windsor—Plans being prepared for filtration plant here. Est. cost, $125,000. James, Proctor & Redfern, Excelsior Life Bldg., Toronto, Engrs.

Fla., Pensacola—City will advertise for bids in near future for extens. and impvts. to water works system. Approximate cost, $220,000. F. D. Sanders, Commr.

Ill., Astoria—Plans being made for water works, including 30,000 gal. impounding reservoir, 200,000-gal. a day rapid sand filter plant, 4 motor driven centrif. pumpg. units, filter plant, pump house, 13,200 ft. 6-in. cast iron mains, etc. $40,000. W. A. Fuller Co., 1917 Railway Exch., St. Louis, Mo. Engrs.

Ind., Bloomington—City Council voted in favor of employing expert hydraulic engineers, and to construct new water sys., either in Griffy Creek or White river valley. Between one and two million dollars may be expended on new water works. Councilmen Lewis, Franklin, Pittinger and Wells appointed to employ engineer.

Ind., Laporte—State Bd. has approved issuance of $100,000 water works bonds for constr. of additional mains.

Ind., Upland—Upland Water Co. plans construction of new electrically equipped water plant. Est. cost $45,000.

La., Plaquemine—City will construct water and light plant.

Mich., Clawson—Plans being completed for water works system: 11,150 ft. 8-in. and 200 ft. 6-in. cast iron mains, 17 fire hydrants, 15 8-in. gate valves, 17 6-in. gate valves with boxes, spcls., 75,000 gal. elevated steel water tank, etc. Ruhling, Holdsworth & Hudson, 16549 Woodward Ave., Highland Park (Detroit, P. O.), Engrs.

Mo., Kansas City—Fuller & McClintock, Cons. Engrs., have outlined impvts. planned for water works system within next six years as follows: Additional high lift pumping capy., requiring constr. of East Bottoms pumping sta. and equalizing reservoir; pressure tunnels betw. Turkey Creek and East Bottoms stations, and at least one discharge main from East Bottom Sta., right-of-way for main tunnel from Platte Clay Co., site to city, etc.

N. C., Davidson—City will construct water works, sewer system and electric light plant. $30,000 sewer bonds voted and $60,000 light and water bonds.

N. Y., Dundee—City considering bond issue in amt. of $125,000 for constr. of water works system.

Okla., Skiatook—City will extend water and sewer systems; voted $44,000 bonds.

Okla., Tyrone—Town Board will soon receive bids for water wks. system, including power house. $70,000. H. Knott, City Engr.

Ore., Portland—Measure authorizing $500,000 bond issue to provide high-pressure water for fire fighting in business dist., may go on ballot at Nov. elec. Proposal now being considered by committee composed of Fire Chf. Young, F. Randlett, Chf. Engr. Water Bureau and O. Laurgaard, City Engr.

Tenn., Memphis—City will issue $1,200,000 water bonds; $1,322,000 street bonds; $100,000 sewer bonds; $252,000 terminal and warehouse bonds.

Tex., Beaumont—City has $350,000 available for impvts. and extensions to water works system.

Tex., Greenville—City considering enlarging water supply. Will vote on $100,000 bonds. A. D. Duck, City Engr.

Tex., Kosse—F. R. Young of Young & Young, Archts., Dallas, interested in organization of company to develop water supply system on Rocky Creek; establish reservoir with storage capy. of 22,200,000 bbls.; construct temp. dam now, later construct perm. dam 300 yds lower down, space bet. the two dams to be used for reserve supply of water.

Tex., Teague—Extensive water works impvts. planned here. J. B. Hawley, Dallas, Cons. Engineer.

Wn., Camas—Plans being prepared for water works impvts., including 7 miles wood pipe. $40,000 Stevens and Koon, Spalding Bldg., Portland, Ore., Engrs.

W. Va., Bluefield—Bluefield Water Wks. Impvt. Co., having plans prepared for mechanical water filters, 2,000,000-gal. capy. Alvord, Burdick & Howson, Engrs., 8 S. Dearborn St., Chicago, Cons. Engrs.

BUYERS' GUIDE

Pumps.
De Laval Steam Turbine Co.
Harris Air Pump Company.
Keystone Driller Co.
Smith Co., T. L., The

Reinforcing For Pavements.
American Steel and Wire Co.
Truscon Steel Co.

Road Building Material.
Kentucky Rock Asphalt Co.
The Texas Co.

Road Binder.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Keystone Driller Co.
Littleford Brothers.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co., The

Road Oil and Preservatives.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Good Roads Machinery Co., Inc.

Rock Crushers.
Austin-Western Road Machinery Co.
The Good Roads Machinery Co., Inc.

Roofing Material.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.
Warren Bros. Co.

Sand Dryers.
Cummer & Son Co., The F. D.
Littleford Brothers.

Saw Rigs.
C. H. & E. Mfg. Co.

Scarifiers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Drag Line.
Pawling & Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Power.
Sauerman Bros.

Sewage Treatment.
Direct Oxidation Process Corp.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Sewer Pipe Joint Compound
The Barrett Co.

Sewer Rods.
Stewart, W. H.

Slide Rules.
Kolesch & Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Machinery Corporation.
Good Roads Machinery Co., Inc.
Phoenix Mfg. Co.

Soaps—Liquid.
Integrity Chemical Co.

Special Castings.
The Flower Company.
U. S. Cast Iron Pipe & Fdy. Co.

Sprinklers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
Austin-Western Road Machinery Co., The

Stone Elevators.
Austin-Western Road Machinery Co., The

Stone Spreaders.
Austin-Western Road Machinery Co., The
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co., The
Littleford Bros.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Paving Material.
The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Road Machinery Co., The

Structural Steel.
Lewis-Hall Iron Works.

Subgrading Machines
Austin Machinery Corp.
The Hug Co.

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Tamping Machines.
Pawling & Harnischfeger.

Tanks, Water Supply.
Littleford Brothers.

Tar and Pitch
The Barrett Co.

Tar Heaters.
Littleford Brothers.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith.
Walter H. Flood.
Howard, J. W.
Kirschbraun, Lester.
Nutting Co., H. C.
Van Trump, Isaac.

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

Tractors.
Austin Machinery Corporation.
Holt Mfg. Co., Inc.

Traffic Signals.
Electrical & Specialty Supply Co.
Little Giant Co.

Trailers.
Lee Trailer and Body Co.

Trench Braces.
Kalamazoo Fdry. & Mach. Co.

Trench Machinery.
Austin Machinery Corporation.
Kalamazoo Fdry. & Machine Co.
Pawling & Harnischfeger.

Turbines, Steam.
De Laval Steam Turbine Co.

Turntables, Truck
The Hug Co.

Valves.
Coldwell-Wilcox Co.
The Flower Company.

Wall Coping.
Cannelton Sewer Pipe Co.

Warrenite.
Warren Bros. Co.

Water Main Cleaning.
National Water Main Cleaning Co.

Water Pipe.
U. S. Cast Iron Pipe & Foundry Co.

Waterproofing.
Barrett Co., The
Pioneer Asphalt Co.
The Texas Co.
Truscon Steel Co.

Water Purification.
Direct Oxidation Process Corp.
Pennsylvania Salt Mfg. Co.

Water Softener.
The Refinite Co.

Water Works Supplies and Equipment.
Coldwell-Wilcox Co.
The Flower Company.
Pennsylvania Salt Mfg. Co.

Wheeled Scrapers.
Austin-Western Road Machinery Co.

Wire Rope.
American Steel & Wire Co.

Windows (Steel).
Truscon Steel Co.

Wire-Cut Lug Brick.
Murphysboro Paving Brick Co.
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The sack method of shipping is most convenient. There are four sacks to a barrel. Each sack contains 94 pounds of cement—a cubic foot. And a cubic foot is a handy volume in proportioning concrete mixtures.

When cement is shipped, the sacks are billed to the purchaser. When they are returned, they are bought back at the same price if they are in usable or repairable condition. This involves much work in checking, cleaning, sorting and repairing.

But in spite of the fact that every good cement sack is redeemable, 30,000,000 of the sacks shipped every year fail to come back—a loss of nearly $5,000,000 a year at present prices of new sacks.

To replace these "lost, strayed or stolen" sacks requires annually over 30,000 bales of cotton. It requires that the textile industry weave a strip of cloth 30 inches wide and 17,000 miles long. It means that 1,600 looms are kept working full time for a year.

Thousands of sacks returned to the cement mills for redemption are damaged, yet accepted for credit, if they can be repaired. This repair is done by the cement manufacturer at his own expense.

A medium sized plant shipping, say 1,000,000 barrels of cement a year, has to repair an average of 6,000 sacks per day from among those returned for credit. This keeps 6 people constantly working at rapidly operated electric sewing machines. In a million barrel a year plant, 22 people are constantly employed sorting, counting, repairing and otherwise caring for returned sacks so that they may again be used.

At the present time $30,000,000 would be a conservative estimate of the investment which the cement industry has in cotton sacks.

Sacks are one of the lesser, but nevertheless important items in the cement industry.

PORTLAND CEMENT ASSOCIATION

A National Organization
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